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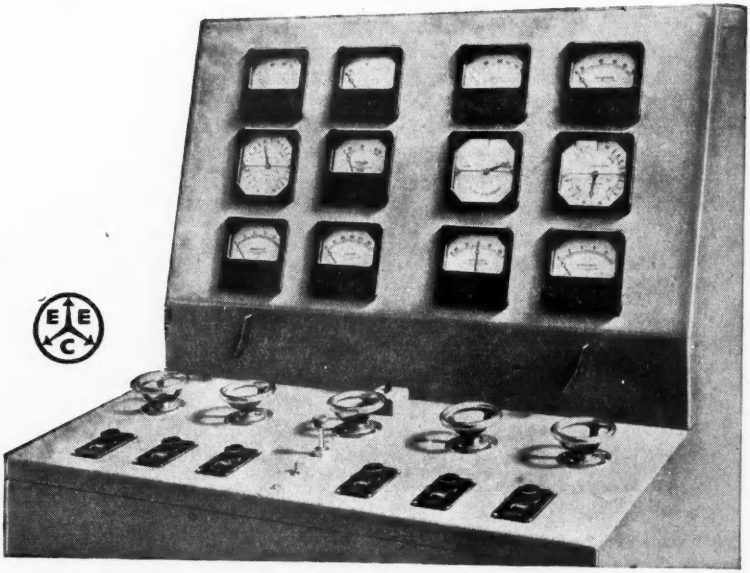
Instruments ...



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ELECTRICAL REVIEW

Vol. CXLIX No. 3855 12TH OCTOBER, 195

THE OLDEST ELECTRICAL PAPER • ESTABLISHED 1872

Electricity in Industry

VALUABLE GUIDANCE ON FACTORY REGULATIONS

THE present advanced state of electrical development in Great Britain owes much to the foresight shown by leaders of the profession in the early years. Their imaginative acceptance of scientific advances and their faith in the future of electricity enabled them to envisage that what were once but scientific possibilities would later come to be of far-reaching practical significance and—what is more—to sketch the framework by means of which barely indicated trends could be successfully applied.

A notable example is furnished by the regulations governing the production and use of electrical energy in factories, which were made statutory in 1908 following a report by Sir James Swinburne. These regulations remained in force until an extension of the scope of factory legislation in 1937 made them of too limited an application.

Obligations under the Act

The Acts make occupiers of factory and certain other premises responsible for providing means for securing compliance with the regulations. They also impose obligations on employees to make proper use of those means. Failure in either case is liable to incur legal penalties. Although copies of the regulations must be supplied free to any worker affected by them, this provision is unlikely to be of real use to those without experience in the interpretation of the necessarily legal phraseology or in grasping all its implications.

Explanatory Memorandum

Almost indispensable aid to that end was given by the then Senior Electrical Inspector of Factories, the late Mr. G. Scott Ram, in a Memorandum which explained the bearing of the Act on practical working conditions. In view of the great importance of the document, it is surprising that it has been out of print for a number of years.

This lack of guidance has now been put right by the publication of a new Memorandum by his successor in office, Mr. H. W. Swann. Continuity has been preserved by the inclusion of old matter where relevant, in particular that relating to the main theme, i.e., prevention of danger, the principal difference being that emphasis has been shifted to newer developments. Room has been made for these by omitting items contained in the previous edition (1924) which no longer merit the attention formerly given to them since they relate to conditions that are now more or less obsolete or to principles of design now accepted as obvious.

Definitions of terms are identical, but the retention of "high pressure," meaning "high voltage," seems of doubtful merit in view of other modern uses of the expression, especially its association with gas or oil filling of high-voltage cables in pounds per square inch. The dividing line at 3,000 V between high pressure and extra-high-pressure no longer seems called for; it was dropped from the Electricity Commissioners' Supply Regulations many years ago. Apart from the value of the more up-to-date explanations and examples cited, the new Memorandum is more attractively presented. Terseness of statement, more readable type and better paragraphing make for a quicker grasp of meanings and should help to secure a wide circulation for a document with which all concerned in industrial applications of electricity ought to be thoroughly familiar.

NATIONALIZATION POLICY

In last week's leading article we expressed some views on the subject of electricity supply as it might be affected by a possible change of Government. We said that it was apparently not the policy of the Conservative Party to denationalize the industry. Since then we have received a copy of "Britain Strong and Free" from the Conservative Central Office. In this it is contended that nationalization of gas and electricity, by excessive centralization, has fettered local initiative and autonomy and has caused unnecessary delay and duplication of staff. It is proposed that "the former system of a Central Electricity Board and Electricity Commissioners should be restored and immediate consideration should be given to a scheme for decentralizing control of generation." The publication says further:—"In both gas and electricity, municipalities and private enterprise should have the opportunity to put forward their claim to re-enter the field." This is somewhat indefinite and surely such a claim could be put forward at any time.

LARGER TRANSFORMERS?

A betatron is, in effect, a transformer with a primary circuit composed of a wound transformer core and a secondary circuit consisting of a stream of electrons circling round a vacuum tube. The main core associated with the betatron at the University of Illinois is claimed to be the largest ever made for operation at 60 c/s; it is of the shell type, the planes of the steel laminations being vertical, in which position they are self-supporting. Construction is similar to that of large power transformers with circular coils, so that if the particular core in question were oil-immersed circular disc windings for from 2,100,000 kVA at 15 kV to 1,200,000 kVA at 230 kV could be placed upon it. Thus is demonstrated the feasibility of making transformers many times as large as those now built, which are limited in weight and size by considerations of transport from factory to destination. The assembly of transformers of unusual physical dimensions on the sites on which they are to operate may become—in future—an economical procedure, because of the saving of weight and better efficiency inherent in large units, notwithstanding the lesser cost of factory erection on a "per pound of material" basis.

NON-COMPULSORY STANDARDS

A report dealing with the recently-published British Standard Specification for "safe" electric fires appearing in the *Birmingham Gazette* was headed: "Firms Must Make Electric Fires Safer." There is, of course, no "must" about it. Unless conformity with British Standards is definitely specified in contracts conformity is purely voluntary. In many ways this is to be regretted. For one thing it penalizes good manufacturers who observe the rules because it is generally more costly to do so. Nevertheless we do not believe that a Private Members' Bill (which is proposed in this case) is the proper way to enforce observance

TURBINE DESIGN

Progress in steam turbine design during the past twenty years has necessitated modifications to B.S. 132. New material in the 1951 edition, reviewed on page 739, relates to such modern but now generally accepted features as instruments for recording the effects of metal expansion, turning gear, governing control with falling vacuum and operation of condensing sets under non-condensing conditions. Provisional limits to variations in high steam pressures and temperatures are further important points to be observed.

Steel Blooming Mills—II*

Auxiliaries—General

By G. G. NICHOLSON, M.Eng., A.M.I.E.E.†

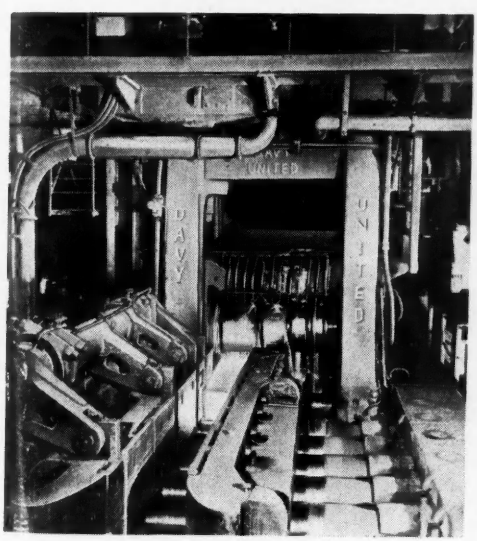
THE mill auxiliaries may be divided roughly into three categories: (1) Immediate main tables and their extensions, breast rollers, manipulators and screwdown gear; since in nearly all cases they have to operate at each reversal of the mill, which may take place ten times a minute, or more, these are truly called heavy duty auxiliaries. (2) Ingot bogie, approach and runout tables, transfer skids, shear stop and measure gear, crop pushers, etc., which are not operated so frequently and also their acceleration rates are not so important. (3) Bloom shears which, while not immediate, may be classified as heavy duty.

It is standard practice to drive all, or nearly all, these items by the d.c. "mill type" motor, which is totally enclosed to keep out scale, dust and spray although it is not classified as weatherproof. The frame is made of steel and is of a heavy construction with widely spaced feet. The frame is split horizontally near the centre line and the armature is fitted with cartridge bearings to enable it to be removed easily when the top half of the frame is lifted. The bearings are normally of the roller type and are liberally proportioned. The shaft is heavy and is extended at both ends so that the motor is reversible in position and the armature is designed to have a low inertia.

There are several kinds of "mill type" motor, but the tendency nowadays is to use those built to the ratings and dimensional standards of the American Association of Iron and Steel Engineers, which are in two series. The 400-series has been in existence for quite a long time and comprises 10 frame sizes for from 5 to 150 h.p., all one-hour rated. The 600-series, first introduced in America two to three years ago and now being made in this country, takes advantage of recent improvements in design and insulating material and while of the same dimensional standards has a one-hour rating equal to that of the next larger frame size in the 400-series.

Features of both series are the very high overload capacity and the possibility of developing the one-hour rated h.p. continuously by furnishing them with an appropriate quantity of ventilating air. Another important feature is that it is possible to run this type of motor at twice its rated voltage with corresponding increases in h.p. and speed.

Reversing 42in blooming mill tables driven by 100 h.p. motor through bevel gear and speed reduction box



* The first part of this article appeared in the *Electrical Review* of 5th October.

† Assistant Chief Engineer (Electrical), Davy & United Engineering Co., Ltd.

Mill type motors may be shunt, series, or compound wound.

The main front and back main mill tables are each composed of a series of solid steel rollers driven by bevels from a lineshaft and reduction gearbox. Their inertia is high and the number of reversals hourly is considerable, thus representing a very heavy peak load. It is not easy to predict the r.m.s. value of the h.p. load owing to the variable friction and frequency of reversals, the latter depending to a large extent on the operator. The main extension tables are of similar, but usually lighter, construction and their duty is not quite so heavy.

Smooth variable speed control with rapid acceleration and deceleration is required, but the series motors widely used in the past are not really suitable for table drives. The starting torque characteristic is such that even if the table is designed to run at, say, mill base speed with full load on the motor, it is unlikely to remain at that speed owing to the wide fluctuations in motor load. The table will accelerate to a speed corresponding to light load (friction loss) on the motor and this speed will normally be in excess of the desired table speed.

Speed control by series resistance does not improve the operation appreciably and is very wasteful of power. Shunt and compound wound motors with contactor control can give quite high starting torques but, as they are essentially constant r.p.m. machines, speed control must be carried out by series resistance, armature divertor resistances, or field weakening. The first two methods are very wasteful of power although good speed-torque characteristics may be obtained by the use of a combination of series and armature divertor resistances. With control by field weakening full motor torque is not available above the normal full field speed of the motors.

With contactor control " plugging " is used to reverse the motors quickly, but high reversing torques cannot be maintained during the deceleration period unless complicated " plugging " circuits are used.

Modern Ward-Leonard control of main tables achieves smooth acceleration. The operator can select the speed of the table more accurately, acceleration and deceleration may be carried out without any heavy main line contactors and there are no heavy losses in starting resistances. A further advantage is that the motor speed may be increased above the rated speed by increase of voltage and full motor torque may be obtained up to twice rated speed. The disadvantages of the Ward-Leonard scheme are the extra cost of the m.g. sets and their maintenance, though it is doubtful whether this maintenance is any greater than that of the heavy contactors of the magnetic type of control.

The breast rollers, situated on either side of the mill between the main tables and the mill rolls, are raised above the table level to help to feed the ingot into the roll gap. There are many different ideas on how they should be operated, but modern practice is to use Ward-Leonard control with means of synchronizing the breast rollers with the mill rolls, or with the main tables, the choice being left in the hands of the mill operator. In the past the breast rollers have been gear driven, but in one new mill in this country they will have directly-coupled low speed motors.

Manipulators

Each mill manipulator head consists of a heavy steel casting, or fabrication, driven by a rack and pinion through a reduction gearbox and " mill type " motor. The inertia is very high, but high controlled speed is not necessary. Rapid controllable acceleration and deceleration are required to move the ingot across the width of the rolls and also to straighten the longer pieces as they issue from the roll gap. Ward-Leonard control is of great advantage here in permitting rapid stopping, which can only be achieved with contactor control by multi-step dynamic braking.

Consideration should also be given to the use of position servo-control of manipulators. At present the operator must move his master controller to initiate the head movement and then he must be able to estimate the distance travelled during deceleration to enable him to return the controller to the " off " position before the head reaches the desired position. A study of the motor contactors shows that the operator's judgment is not good and a considerable amount of inching is necessary. Good servo-position control would make the head follow the control lever, the displacement of which would be proportional to head movement and not head speed as at present.

One of the manipulator heads is fitted

with tilting fingers, used for turning over the ingot, or bloom, to enable it to be reduced in two directions at right angles. The fingers are lifted by a tilting shaft carried by the traversing head and operated by a crank motion. One revolution of the crank raises the fingers to the top of the travel and returns them to the bottom again. The inertia is not exceptionally high and usual practice is to use foot pedal actuated non-reversing dynamic braking contactor gear.

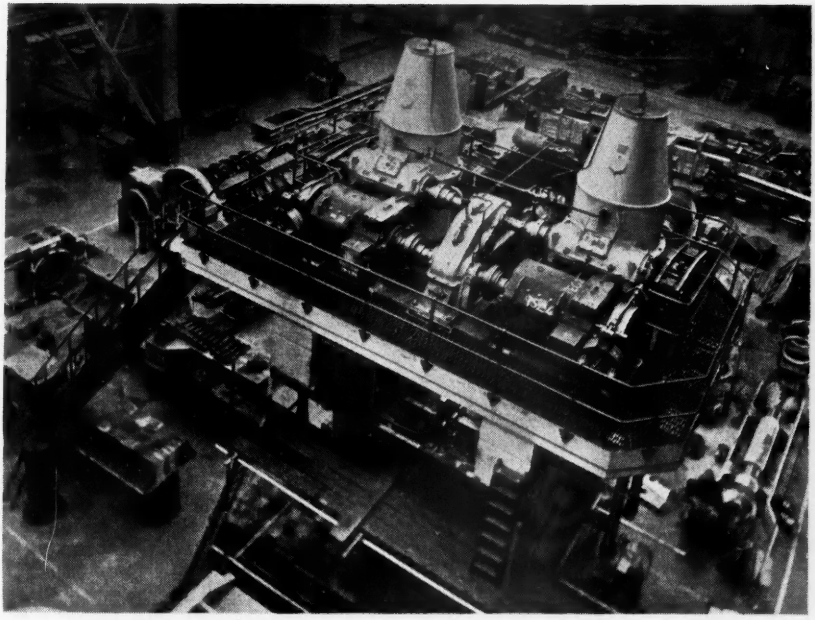
To operate the screwdown gear which moves the top mill roll assembly against the pressure of hydraulic jacks, two motors are usually employed, one on each screw, mechanically coupled through a clutch. The latter when disengaged allows the screws to be moved independently for roll levelling. Screwing speeds vary considerably, depending to a large extent on the size of ingot and the reductions being taken. A normal blooming mill has a speed of the order of 200 to 240 in/minute.

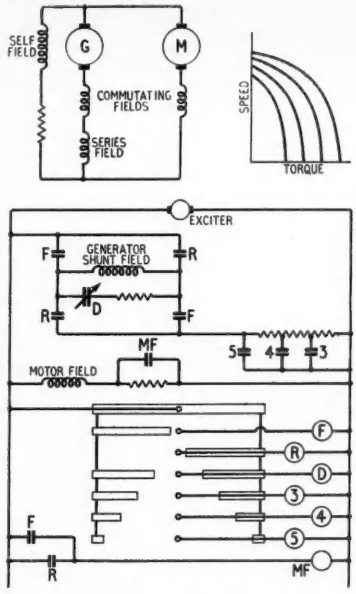
The drive is, of necessity, inefficient owing to the design which is such that the screws do not " back off " under rolling load. The inertia is very small by comparison with those of the auxiliary drives considered so far. The requirements for this drive are similar to those of the manipulator heads, namely, quick acceleration and deceleration with accurate stopping; again Ward-Leonard control is coming into favour for screwdown drives.

Some plate mills have been fitted with automatic screwdown gear which enables the top roll setting to be changed by the operation of a foot pedal after every pass, but this is not possible on a blooming mill where the rolling schedule has to be modified to allow for the varying state of ingots received at the mill. Ingot temperatures vary appreciably and it is safer to allow the screwdown setting to be in the hands of a skilled operator. Of course some operators are not as skilled as others and it has been said that some have been seen to carry out forging with the screwdown gear.

There are very many auxiliaries which, although subjected to very heavy stresses,

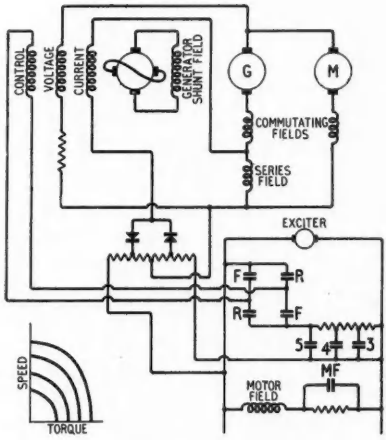
Twin-motor screwdown assembly for 42in slabbing mill under erection in maker's works





Left: **Ward-Leonard control diagram with three field generators**

Below: **Ward-Leonard control diagram with quick-acting exciter**



may be classified as of lighter duty than those already discussed.

First there is the bogie which carries the ingot from the soaking pits to the receiving table. It may have one or two travelling motors and sometimes other motors for tilting the ingot chair and operating a couple of driven rollers on the table. To enable the motors to be of the same type as those on the lighter duty roller tables, it is normal practice to use the compound wound type with reversing dynamic braking control. Divertor control is necessary, in addition, on the ingot chair tilting device as heavy regenerative loads are encountered. Ward-Leonard control has been used for ingot cars in America, but its advantages are slight in this instance.

The ingot is tilted on to the receiving table, which is usually slow running; it carries the ingot to the mill approach extension table and does not have to operate quickly. The number of operations hourly is not great and the table is usually driven by a compound wound " mill type " motor with reversing dynamic braking control.

Similar tables take the bloom, or slab, when rolling is complete down to the bloom shears for end cropping and cutting to length, while the cut lengths are taken on similar tables to transfer banks.

Auxiliaries associated with the bloom shear are the crop pusher, shear measuring gear, pullback table shifter and rollers and the shear sideguards, nearly always driven by a compound wound motor with reversing dynamic braking control.

There are several kinds of bloom shears. The direct electric type is quite common, the shear blades being actuated by toggle or bootstrap linkage from a heavy shaft which is gear driven by a d.c. motor. The control gear causes the motor to slow down when the cut starts so that some of the kinetic energy of the rotating parts is given out to help the motor perform the cutting operation. Afterwards the shear again accelerates until it is stopped with the blades fully open by a limit switch. The time available for acceleration before the cut is only of the order of two seconds so that this system, while satisfactory in operation, causes very heavy peak loads. Thus the motor (r.m.s.) power bears little relationship to the average h.p. requirements of the shear.

One recent shear for heavy slabs has two

1,000 h.p. motors and the peak power they demand from the generators is so great that these generators are to be mounted on the main mill motor Ilgner set.

Some bloom shears have a flywheel and air clutch brake arrangement driven by a standard industrial slipring motor with slip resistance in the rotor circuit. Clutch and brake maintenance can be considerable. The simplest of all from the electrical engineer's viewpoint is the hydraulic shear, the only motors involved being those driving the pumps, with a hydraulic accumulator to level peak demands.

Ward-Leonard Control

There are two kinds of Ward-Leonard control, both having automatic current limit features. First there is the well-known three field generator that has self- and separately-excited shunt fields and a series differential field, which combine to give the generator the " shovel " characteristic. The second type is a normal shunt wound generator with a quick-acting exciter. The latter has a separately excited shunt field, a differential feed-back field excited by the generator armature voltage and a differential current limit field arranged to operate when the amperage exceeds a preset value.

The speed-load curve of the second type is similar to the " shovel " curve, but is flatter in the light load region and has a much sharper cut-off at the selected current limit. The cost of the second type is slightly higher than that of the first because of the cost of the additional exciter, but it has been proved that the response is much quicker.

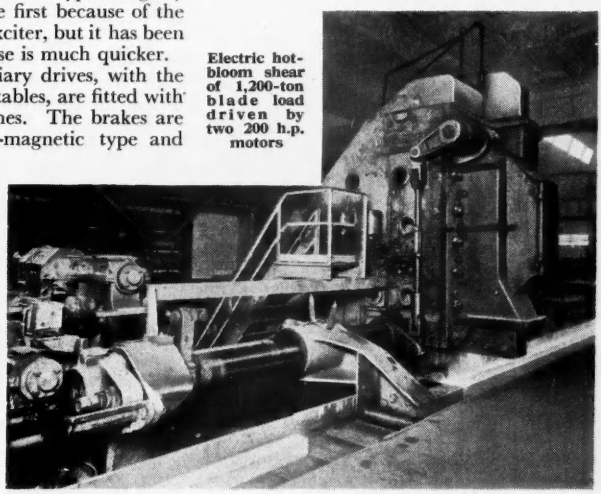
Almost all the auxiliary drives, with the exception of the roller tables, are fitted with brakes and limit switches. The brakes are of the normal electro-magnetic type and may be series or shunt wound. It is common practice to mount the brake on the spare shaft-end of the motor although some people contend that, as the motor is provided with two shaft-ends and is reversible, it loses the latter feature if the brake is mounted at the back. The alternative is to provide a combined brake drum and coupling.

It is possible on most drives with limit switches for them to be of the rotary cam type, as a series of track switches is not then necessary; the setting is easily adjustable and cabling is reduced. Track switches, where used, should be of very heavy construction with large rollers.

It is usual to furnish the main Ilgner set and mill motor with ventilating air; in addition, the bloom shear motor is force-ventilated and recent practice is also to force-ventilate the immediate auxiliary motors, driving main mill tables and their extensions, the manipulators and the screwdown. It is best to draw air from outside through filters into the motor room and down through the machines to the basement. If the air is cooled and then recirculated, the filter capacity required will be much smaller.

Small a.c. motors for driving small exciter sets, lubrication and hydraulic systems are as important as other auxiliaries. For the lubrication systems, for instance, the motors and pumps are duplicated with automatic changeover initiated by pressure switches in case of failure.

The author thanks the Davy & United Engineering Co., Ltd., for access to information and John Lysaghts (Scunthorpe Works), Ltd., the Steel Company of Wales, Ltd., the English Electric Co., Ltd., and the Metropolitan-Vickers Electrical Co., Ltd., for the illustrations.



Electric hot-bloom shear of 1,200-ton blade load driven by two 200 h.p. motors

NEW BOOKS

A.C.—D.C. Test Meters. By W. H. Cazaly and T. Roddam. Pp. 180; figs. 112; appendix and index. Sir Isaac Pitman & Sons, Ltd., Parker Street, Kingsway, London, W.C.2. Price 18s.

The authors have endeavoured in this book to outline the factors influencing the circuit design of multi-range meters of the type used for general purpose testing. Following an introductory chapter on the construction of moving coil movements, the design of d.c. voltage, current and resistance ranges are discussed and formulæ derived for determining component values. The characteristics of metal rectifiers are outlined together with the limitations of the basic rectifier circuits when applied to a.c. measurements.

The advantages obtained from the use of potential and current transformers leads to a rather tortuous description of the somewhat difficult subjects of transformer theory and design. The concluding chapters deal with the specification of accuracy of indication of measuring instruments, the design of power and capacitance ranges, and suggestions to aid the amateur in the construction of a multi-range meter.

The reviewer feels that this book will be of assistance to the amateur and enable the home constructor to produce a serviceable test meter.—H.B.W.

The Oxide Coated Cathode. Vol. I. By G. Herrmann and S. Wagener. Pp. 148; figs. 78; index. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 21s.

This book is the English translation of a German work which was published in 1944. In the process of translation the book has been revised and brought up to date. In the present edition Vol. I deals with the manufacture of oxide cathodes, the theory being considered in Vol. II. The book begins with the preparation of sleeve and spray, leading to the manufacture of the complete cathode and heater. Next follows processing in the envelope, after which a chapter is devoted to the characteristics of oxide cathodes. The final chapter deals with cathodes for purposes other than receiving valves, such as in thyratrons and fluorescent lamps.

The book is very well illustrated and contains a wealth of graphs and tables giving answers to most of the questions arising in the technical use of cathodes. Emission and temperature measurements are discussed without many details, but these are presumably covered in Vol. II. In the German original very little was said about pulsed operation of cathodes. This is less noticeable in the revision, but pulse operation is still given a minor role. The section which deals with the chemical preparation of the carbonates could, with advantage, be much expanded. Apart from these minor criticisms, the book will be welcomed by valve technicians as the first modern account of all phases of cathode production, and can be thoroughly recommended. The price, however, seems high for such a short book.—A.H.B.

Books Received

Electromagnetic Theory, Vols. I, II & III. By Oliver Heaviside, F.R.S., with a critical and historical introduction by Ernst Weber. Pp. 386; figs. and index. E. & F. N. Spon, Ltd., 22, Henrietta Street, London, W.C.2. Price 63s in U.K.

Electric Power Engineers' Handbook. By W. S. Ibbetson. Third edition. Pp. 298; figs. 126; index. E. & F. N. Spon, Ltd. Price 22s.

Transients in Electric Circuits using the Heaviside Operational Calculus. By W. B. Coulthard. Second edition. Pp. 260; figs. 97; appendices and index. Sir Isaac Pitman & Sons, Ltd. Price 32s 6d.

Technical Sketching. By E. F. Waller. Pp. 60; figs. 38; index. Sir Isaac Pitman & Sons, Ltd. Price 6s 6d.

Basic Electrotechnics. By B. L. Goodlet. Pp. 247; figs. 139; index. Edward Arnold & Co., 41, Maddox Street, London, W.1. Price 21s.

Applied Electricity. By H. Cotton. Pp. 451; figs. and index. Cleaver-Hume Press, Ltd., 42a, South Audley Street, London, W.1. Price 17s 6d.

Sound Film Projection. Edited by E. Molloy. Fourth edition. Pp. 338; figs. and index. George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2. Price 30s.

Surface Chemistry. By A. E. Alexander, M.A., Ph.D. Pp. 70; figs. 34; index. Longmans, Green & Co., Ltd., 6 and 7, Clifford Street, London, W.1. Price 7s 6d.

Polyphase "Fractional" Motors

Outline of Principles Involved

By S. F. PHILPOTT,
M.I.E.E.

THE majority of fractional-horse-power motors in use to-day are single-phase, either induction or series-commutator (universal), types. Such questions sometimes arise as: why should this be so, what are the merits and disadvantages of the polyphase f.h.p. motor compared with the others and, if it is shown to possess advantages, what can be done to operate it from single-phase input mains?

Most "fractional" motors are used in domestic and light commercial and industrial appliances in situations where only single-phase mains are installed, so that the use of a three-phase motor is automatically precluded. This condition does not obtain in factory installations where three-phase mains are generally available in addition to single-phase. Thus three-phase motors can be used in such places if and when they are suitable for the machines they are intended to drive.

There is a general tendency towards the individual driving of even small machine tools and appliances, for which three-phase motors are mostly used. A difficulty arises when a machine is built with a self-contained three-phase motor and it is then installed in a factory where there is only single-phase distribution and the substitution of a single-phase motor is difficult, or impossible, on account of its greater size.

The polyphase motor, compared with the single-phase induction type, is smaller for a given output because the active materials are more fully utilized. It is more simple in construction because there is no centrifugal switch, capacitor, or equivalent starting device. It is thus cheaper and more reliable. The centrifugal switch is in general the weakest link in a single-phase induction motor.

From the manufacturing point of view, whereas most single-phase motors are wound for inputs not exceeding 250 V, corresponding three-phase motors must be wound for 400 V and upwards. The space taken by the additional insulation presents a certain amount of difficulty, particularly in the small sizes, and polyphase motors are therefore rarely made in sizes less than $\frac{1}{8}$ h.p. The majority of light machine tool applications call for at least $\frac{1}{4}$ h.p., so that this objection is not serious.

Like any other induction motor, the running speed depends upon the input frequency and the number of poles in the stator. At 50 c/s the maximum speed obtainable (that is when using a two-pole winding) is limited to 3,000 r.p.m. synchronous, or a load speed of about 2,850 r.p.m. This compares unfavourably with the series-commutator motor with which load speeds of 10,000 to 12,000 r.p.m. are readily obtainable, accompanied by a corresponding reduction in size and weight of the motor. The only way in which the speed of a two-pole induction motor can be increased is by increasing the input frequency; to enter the field normally covered by the universal motor, a frequency of the order of 200 c/s is required to give a synchronous speed of 12,000 r.p.m. with a two-pole motor.

Compared with the "series" characteristic of the universal motor, the induction motor suffers only a small drop in speed as the load increases. This fact is of particular value in such applications as portable electric tools and has led to the development of a range of what are usually known as high-cycle motors. They need their own special input supplies, wiring and plugs, but this is not a serious disadvantage where a number are used within the limits of a production line or in similar circumstances.

There are two methods of supplying a.c. for high-cycle motors. Where the basic system is d.c. a motor-alternator set is used to give an output usually at 125 V, 200 c/s three-phase. When the basic system is three-phase a.c., a frequency convertor is employed. In the case of a 50 c/s input this device comprises a specially wound six-pole slip ring motor excited from the a.c. mains and driven by a two-pole induction motor in the opposite direction to that of the rotating field. The resultant

frequency of 200 c/s (synchronous) is that of the exciting circuit plus that due to the reversed rotation of the rotor. Three-phase f.h.p. induction motors running off 333 and 400 c/s input circuits are also used in Service equipment.

For most industrial applications the upper limit of 3,000 r.p.m., which is obtainable with the normal 50 c/s input, is all that is required; the need is more often for lower speeds. Practically all polyphase "fractional" motors are made with cage rotors and the only way in which their speed can be reduced is by increasing the number of poles, the speed being determined by the formula:

$$\text{R.p.m.} = \frac{\text{Frequency} \times 60 \times 2}{\text{No. of poles}}$$

In the case of large motors in which there is ample room for the windings, stators can be wound with many poles without difficulty. In the case of f.h.p. sizes the number of poles is limited by the difficulty encountered in the design and insertion of the winding, and in practice small machines are rarely made with more than eight poles and the available speeds are thus: 2 poles = 3,000 r.p.m.; 4 poles = 1,500 r.p.m.; 6 poles = 1,000 r.p.m.; and 8 poles = 750 r.p.m. The speeds fall a little with load. It is not possible to obtain intermediate speeds with cage rotor machines. A certain amount of speed regulation can be obtained if a wound rotor machine is used and resistance is introduced into the rotor circuit. As the volt drop depends on current flowing due to the load, it follows that such regulation is fully effective only under load conditions. At no load the rotor current is small, the voltage drop due to the resistor is also small, so there is but little deviation from synchronous speed. The level speed characteristic of the cage machine is thus lost. The majority of three-phase f.h.p. motors are of the cage type.

Change-Speed Motors

Some machine tools have to run at one of several different speeds, often done by means of a mechanical gear box, but it is sometimes more convenient to change speed electrically. As mentioned above, for a given input frequency the speed of a cage induction motor (apart from variation due to the load) is controlled by the number of poles in the stator. Thus to change the speed of a motor, the number of

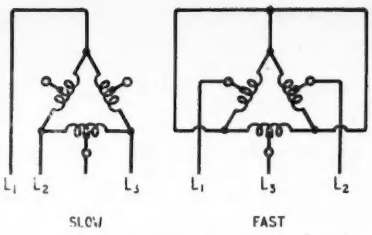


Fig. 1.—Stator winding connections for changing number of poles

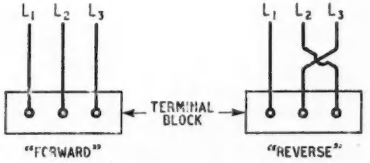


Fig. 2.—Changing rotation of three-phase induction motor

poles in the winding must be changed. One method of doing this is to put two entirely separate windings on the stator, for example, one wound for two poles and the other wound for four poles, and provide a switch so that one or the other can be used at will. For this arrangement the size of the slots and the diameter of the stator must be increased to accommodate the two windings so that the motor is both larger and heavier than the corresponding single-speed motor. One winding is idle all the time that the motor is running.

A more economical solution is to use a single winding wound with midpoint tappings brought out from each phase so that the sections may be operated in series or parallel in the manner shown in Fig. 1. Such a winding could, for example, have two or four poles giving a choice of speeds of 3,000 or 1,500 r.p.m. By deepening the stator slots another winding could be put in, having say six and twelve poles, with a suitable arrangement of switching to make speeds of 500, 1,000, 1,500, or 3,000 r.p.m. available.

In small frame sizes it is difficult to provide for more than two speeds owing to lack of available winding space. According to the requirements of the drive, the windings can be arranged so that there is approximately the same torque at each speed (that is variable h.p.) or reduction

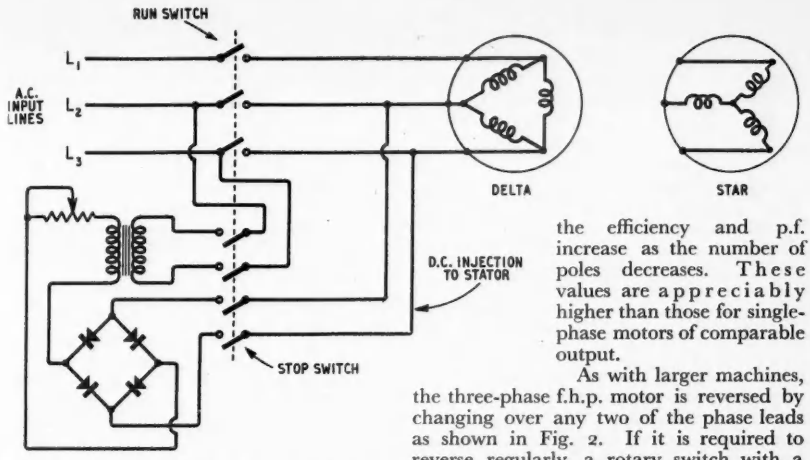


Fig. 3.—Stopping three-phase f.h.p. motor by d.c. injection

of torque as the speed increases, giving a constant horse power.

Polyphase f.h.p. motors are usually started by directly switching them on to the line. Star-delta starting is rarely employed; push-button control is very popular. The starting torque of three-phase f.h.p. motors is of the order of $2\frac{1}{2}$ to $3\frac{1}{2}$ times the full load torque and thus they compare favourably with split-phase motors with starting torques ranging from $1\frac{1}{2}$ to 3 times full load effort.

The starting current of the polyphase machine is much smaller, 5 to 6 times the full load value, as against 7 to 10 times the full load current of the split-phase types. The capacitor-start single-phase motor has a greater starting torque ($3\frac{1}{2}$ to $4\frac{1}{2}$ f.l.) and a smaller starting current (4 to 5 f.l.) than the three-phase type.

Because it has a rotating field of practically constant intensity the polyphase motor runs with less vibration than corresponding single-phase induction motors, which have pulsating fields. The maximum torque ranges from 3 to 4 times the full load value and is slightly greater than that of any of the single-phase motors, which range broadly, according to type, from 2 to $3\frac{1}{2}$ times full load torque.

The efficiency of small three-phase motors ranges between 65 and 70 per cent and power factor from 0·65 to 0·8. In general the efficiency and p.f. increase as the number of poles decreases. These values are appreciably higher than those for single-phase motors of comparable output.

As with larger machines, the three-phase f.h.p. motor is reversed by changing over any two of the phase leads as shown in Fig. 2. If it is required to reverse regularly, a rotary switch with a centre "off" position is very convenient.

Unlike single-phase induction motors, a polyphase motor may be reversed when running. This fact provides the means of bringing it to a quick stop, by what is known as plugging. The switch must be brought to the "off" position before the rotor has time to reverse, or this operation may be done automatically by a centrifugal switch on the rotor.

Another method of stopping, which provides for adjustment of the braking torque and precludes the possibility of actual reversal, is to switch off the a.c. input and then inject d.c. into the stator windings. In this condition the rotor acts as would a short circuited armature in a d.c. motor. The d.c. may conveniently be obtained from a rectifier connected to one phase (Fig. 3), variable resistance being provided for the purpose of regulation.

With the exception of the shaded pole motor, with which it can hardly be compared, the polyphase motor is the simplest of all the f.h.p. types and may therefore be considered as the most reliable.

It consists of a stator built of laminations which are slotted on the inside to receive the windings and secured on the outside by a "shell" which may be a casting or piece of sheet steel tightly wrapped over the stampings. In the bore of the stator is a rotor mounted on a shaft. Two kinds of rotor are in use, the built-up copper cage design and the cast aluminium type.

In the former, holes are punched in the

rotor laminations and they are filled with copper bars, the ends of which are fitted into copper end-plates, similar to the laminations, but much thicker, and then soldered, brazed, or welded. In the cast type of rotor the laminations are built up and then aluminium alloy is poured in and around them so that the bars and end rings form one homogeneous casting. A ventilating fan is usually mounted on the shaft and, in cast rotors, it takes the form of fins projecting from the end-winding. Two end brackets are fitted to the stator to carry the bearings, terminal block, etc.

Most industrial motors have end brackets with ventilation holes, or slots, so designed that the motor is virtually drip proof. Totally enclosed types are available, also totally enclosed machines with external fan cooling. As with other forms of f.h.p. motor various methods of mounting are solid foot, flange, and resilient. In some special types of three-phase motor the rotor runs externally to the stator.

Operation on Single-Phase Mains

From the foregoing it will be apparent that the three-phase f.h.p. motor has a number of advantages over its single-phase counterparts in size, performance, reliability, and capital and running costs, so it should in general be used whenever three-phase a.c. mains are available. Generally where such a supply does not exist the obvious and most economic solution is to use the single-phase motor most suited to the work to be done. Cases arise, however, in which the use of three-phase motors is desirable even though only single-phase a.c. is available. This happens sometimes in factories operating on a single-phase system when it is desired to use machine tools which are normally supplied with built-in three-phase motors. It is quite possible that the motor compartment will not be large enough to take a single-phase motor of equivalent output, besides which all the control gear would have to be rearranged.

To meet such situations three methods of obtaining three-phase power are: (1) by a motor-generator set having a single-phase driving motor and a three-phase alternator, (2) by the Ferraris-Arno system of phase conversion and (3) by static conversion.

System (1) is generally considered to be expensive and inefficient. The generator and motor must both be capable of carrying

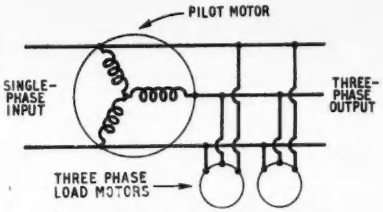
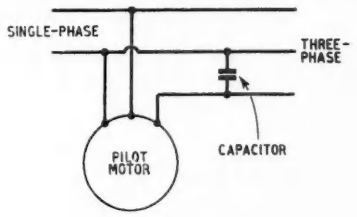


Fig. 4.—Ferraris-Arno system of operating three-phase motors from single-phase mains

Fig. 5.—Capacitor Ferraris-Arno single- to three-phase system (B.T.H.)



the full load of the shop and are thus relatively large and costly machines. In its elementary form system (2) phase conversion is by the use of a pilot motor which runs light from the single-phase mains and has the three terminals of its primary winding connected to the outgoing three-phase circuit as shown in Fig. 4. The principle of operation is that when the single-phase motor is running light there exists an almost uniformly rotating magnetic field which cuts the windings of the stator and induces almost equal voltages between them—that between the third line and either of the phase wires being, however, lower than the single-phase voltage. To overcome this effect the turns of the third phase are usually modified so that a somewhat higher voltage is generated.

In operation, the pilot motor is first switched on to the single-phase mains by using a phase splitter for starting, thus supplying the three phase output lines to which the normal three-phase motors are connected and started in the usual manner, one after another. Any number of motors may be connected to the system, but each addition causes a reduction in voltage between the third line and the two single-phase lines, which in turn reduces the permissible loading of the connected three-phase motors.

Generally, however, it is desired to retain the full rated capacity, so to overcome this difficulty the capacitor Ferraris-Arno system has been developed by the B.T.H. Co., Ltd. As shown diagrammatically in Fig. 5 the pilot motor, usually having a three-phase symmetrical winding, has a capacitor connected between one of the single-phase terminals and the third line terminal. The effect of the capacitor is to raise the third line voltage and hold it more constant in relation to the load, and to increase the capacity of the pilot motor.

Static Phase Conversion

An elementary scheme for obtaining a three-phase output from a single-phase input without using rotating machines is shown diagrammatically in Fig. 6, the values of the inductance L and the capacitor C being so adjusted that the voltages across each become equal to the single-phase voltage. This system is only suitable for one value of load. If the latter is changed then the values of the inductance and capacitance must also be changed. It is therefore unsuitable for the operation of motors.

In the Westinghouse system of static phase conversion the problem of adjusting the values of inductance and capacitance to suit varying loads is solved by connecting a further inductance in parallel with the capacitor and proportioning the operating flux so as to bring about a change in their values as the load varies. In practice the two inductances are not made separately, but are wound on the outer limbs of a three-phase core type transformer as shown in Fig. 7.

By providing tappings in the coils the phase convertor can be made to operate as a three-phase auto-transformer enabling, for example, a 200/240 V single-phase input to be converted directly to a 400 V three-phase output. In doing this the capacity of the convertor is rather less than if the three-phase voltage remains the same as that of the single-phase input.

The aggregate capacity of the convertor is determined largely by the starting currents of the motors involved. It is thus advisable to arrange that when a large number of f.h.p. motors is connected to one phase convertor, they should be started in succession rather than in groups.

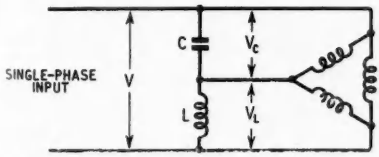
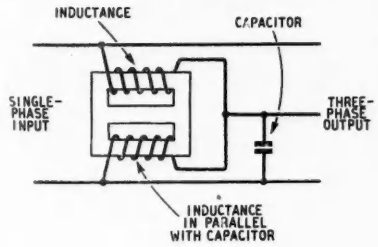


Fig. 6.—Simple method of operating three-phase constant load from single-phase mains

Fig. 7.—Principle of Westinghouse static phase conversion system



STREET LIGHTING NOTES

A CONTRACT for the relighting of NEWRY, Northern Ireland, has been placed with Siemens Electric Lamps & Supplies, Ltd. The scheme, which will be entirely fluorescent, will cost between £16,000 and £17,000.

On 28th September Councillor J. Anderson, chairman of the South East Special Districts Committee, Stirling County Council, switched on a new street lighting installation at LAURIESTON, FALKIRK, comprising 65 sodium lamps.

MARKET HARBOROUGH U.D.C. is seeking Ministry of Transport approval for a £8,666 street lighting improvement scheme for the centre of the town, including mercury vapour lamps along a section of the trunk road and fluorescent lighting along parts of High Street and St. Mary's Road.

Electric street lighting was officially switched on for the first time at DAWLEY, Shropshire, recently. About a mile and a quarter of the main north to south road which passes through the town is being lighted by 52 85 W sodium lamps and 217 100 W lamps have also been installed throughout the urban area.

NARBOROUGH, Leics, Parish Council is considering the conversion of street lighting from gas to electricity.

HASLEMERE U.D.C. has approved a scheme estimated to cost £25,000 for the conversion of street lighting from gas to electricity.

Jointing H.V. Cables

Solid Parallel Branch Tee-Connection

TO cater for the growing need to make solid tee-connections to underground feeder cables W. T. Henley's Telegraph Works Co., Ltd., now have available a parallel branch joint, the constructional features of which follow very closely those of the well-known Henley straight-through joint for 3·3 to 11 kV. The new joint covers the same voltage range and is suitable for 3-core p.l. and a. cables up to 0·2 sq in on the main and branch. Only one size of lead box and cast-iron protection box is available, which should meet the majority of requirements. It is not necessary to cut the main cable; grip-type sleeves are used for jointing the branch to main conductors and the standard impregnated jointing materials, as used for straight-through joints, are employed, but with an additional quantity of impregnated paper-cotton tape, which is supplied in a separate sealed tin. The lead box is split on the centre line, pressed from extruded sheet and is flanged like the company's lead and copper service boxes. Provision is made for bonding the lead of the cable to the c.i. protection box. The branch may be taken off from either side of the main cable.

For tests in the Henley research laboratories a joint was made of 0·15 sq in 11 kV 3-core cable on main and branch with the three cores bunched in the usual way for type-test, consisting of ten negative and ten positive impulses, 1/50 wave, at a voltage based on the formula 4·5 (E + 10) kVp (E being the rated line voltage) and the required withstand-voltage test of 95 kVp was satisfied. The negative voltage was then increased in steps until breakdown occurred at 237 kVp.

For 50 c/s breakdown test another 0·15 sq in 11 kV joint was first subjected to the 3-phase voltage type-test of 2E to earth for 15 minutes (E being the rated line voltage) and then the voltage was raised in quarter-E steps at 15 minute intervals until breakdown occurred at 46·75 kV to earth, representing $4\frac{1}{4}$ times the rated line voltage. These tests show that the new parallel branch joints have a high factor of safety.

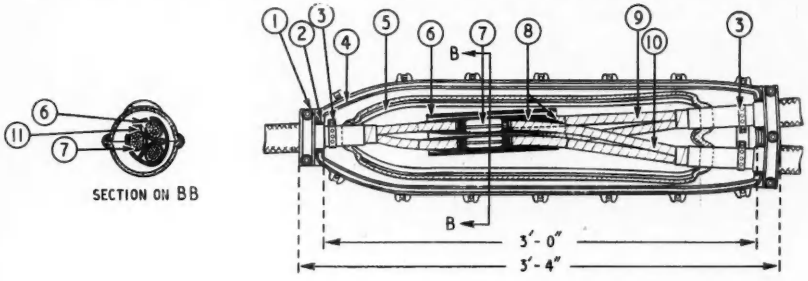
A.S.E.E. Competitions

MEMBERS of the Association of Supervising Electrical Engineers are invited to submit papers for the 23rd annual competition for the W. E. Highfield Shield. In addition to the shield there are three cash prizes. Members are also invited to enter for the fifth annual competition for the Thurston award, consisting of a silver trophy and a cash prize of £10, for the invention or idea judged to be the most valuable contribution to the advancement of the utilization of electricity or the improvement of distribution or installation technique.

The value of the prizes in the Highfield Shield competition has been increased and the scope of the inventions competition has been widened to include ideas of merit as well as inventions which are the subject of patents. The closing date for both competitions is 31st March, 1952; particulars may be obtained from the General Secretary, 54, Station Road, New Barnet, Herts.

Parallel branch joint for Henley 3.3 kV to 11 kV cables

(1) Armour clamp, (2) 2in wide lead/tin alloy strip, (3) perforated t.c. strip for bonding lead sheathing, (4) c.i. box with large filling and inspection covers, (5) lead box with horizontal flanged joint, (6) paper binder (impregnated), (7) standard grip-type sleeve to suit sum of conductor sizes, (8) paper cotton tape insulation (impregnated), (9) uncut main cable, (10) branch cable, and (11) paper separator (impregnated) with metallized paper screen



VIEWS on the NEWS

By REFLECTOR

THE journal of the Southern Electricity Board, *Southern Electricity*, reports that recently a farmer in the Reading District telephoned the local office of the Board to say that his fields were lit up by a bluish light which appeared to emanate from some h.v. distributors. With a great deal of difficulty (this was at 11.30 p.m.) men from the Board made their way to the spot and saw the light coming from behind a screen of trees. When they arrived they were astonished to find a 400 W mercury discharge lamp and 5ft tripod. Nearby was a mobile petrol-driven generator set and two naturalists who displayed a remarkable catch of moths which they had obtained by this unusual arrangement.

* * *

I have been wondering how long it would be before the restrictions on the use of certain materials in the manufacture of domestic electrical appliances would begin to make themselves apparent. In a showroom window a few days ago I noticed a kettle, the original model of which, brought out a few months ago, had a chromium plated copper body: the new model was of anodized aluminium. While this finish is quite attractive, the apparatus has not the same "eye appeal" as the chromium model. In certain areas, in particular certain parts of Scotland, aluminium is unsuitable since it is attacked by the water. Vitreous enamelled steel appears to be the only alternative finish available and this almost inevitably presents a "utility" appearance.

* * *

Now that the number of television licences is fast approaching the million mark I hope that the implementation of the proposed regulations dealing with radio interference suppression will be accelerated. There seems to me no reason at all for delaying the obligation for fitting suppressors, at any rate on the most serious offender, the motor car, which is one of the simplest to deal with. That the car owner is, of course, inclined to be reluctant to incur an expense which may not benefit him is understandable but the cost is so small (about 2s) that it is scarcely worth quibbling about. For my part, for the sake of getting the matter dealt with speedily, I should be inclined to present each car owner with a suppressor and impose a penalty if it was not fitted within, say, a month. As the job takes about half a minute this should allow plenty of time.

* * *

Apparently not only the amenities but also the wild goats of North Wales are threatened by the proposed hydro-electric schemes. Referring to these goats in the *Montgomery County Times* a writer says:—"One wonders what will happen to these —and other wild animals—if the Electricity Authority is allowed to work its destructive will." Shall I soon hear that the B.E.A. is also being hounded by the R.S.P.C.A.?

* * *

Who is (or was) Hephaestus? According to Mr. H. C. A. Gaunt (Headmaster of Malvern), in an article in the *Spectator*, he is (or was) the God of Fuel and Power. He is, I imagine, a god by whom burnt sacrifices would be appreciated, provided the canons of thermal efficiency were observed. Maybe the present sufferings of his devotees can be traced to their disregard of this proviso.

* * *

When the Mayor of Brighton (Alderman E. Simms) recently ascended the 350ft chimney of the new Brighton "B" station he is reported by the *Brighton and Hove Herald* to have found the Red Ensign "fluttering in the strong breeze." (Ensigns invariably flutter.) But, I would ask, what was it doing there? I thought the Merchant Navy had the exclusive use of the Red Ensign. Perhaps it came from one of the B.E.A.'s colliers.

PERSONAL and SOCIAL

News of Men and Women of the Industry

THE Electrical Contractors' Association has elected **Mr. Philip G. Wallis,** Associate I.E.E., as a Fellow of the Association, of which he was president in 1950-51. Mr. Wallis has been a member of the E.C.A. since 1928; he has been honorary secretary of the Maidstone Branch since 1934 and has been chairman of the Maidstone and East Kent Branches and the South Eastern Sectional Board. He was elected to the E.C.A. Council in 1941 and to the Executive Committee in 1947.

Mr. G. A. Paisley, B.Sc.(Eng.), A.M.I.E.E., who has been manager of the Malvern District of the Midlands Electricity Board since 1948, and was formerly with the Malvern U.D.C. Electricity Department, has been appointed manager of the Redditch District of the Board. The Malvern and Worcester Districts of the Board are being amalgamated under the management of **Mr. H. F. Hudson,** A.M.I.E.E., the manager of the present Worcester District. **Mr. A. J. R. Daly,** who has been the consumers' engineer at Malvern for the past two years, becomes branch manager at Malvern.

Mr. J. W. Steeley, A.M.I.E.E., A.M.I.Mech.E., A.M.Inst.F., has been appointed station superintendent of the Stuart Street power station, Manchester. Mr. Steeley, who has been deputy superintendent at Stuart Street since 1948, succeeds **Mr. J. Whitfield,** who has taken up an appointment as generation engineer (operation) of No. 3 Sub-Division in the British Electricity Authority's North Western Division. Mr. Steeley was educated at Hymers College, Hull, and the Hull Technical College, and served in that city's electricity undertaking from 1933 until 1946, in which year he became shift engineer in charge at Stuart Street station. He remained there until March, 1947, when he was appointed assistant station superintendent with the I.C.I. (General Chemicals Division) at their Weston Point power station, Runcorn. In January, 1948, he was promoted to resident engineer at the Pilkington-Sullivan power station, Widnes, and later in the same year returned to Manchester.

Mr. J. W. Steeley

Mr. T. B. Parker, chief rubber cable technologist to Johnson & Phillips, Ltd., has been presented with an inscribed silver cigarette box in appreciation of his fifty years' service with the company. For many years Mr. Parker has played an important part in the preparation of the basic C.M.A. specifications, and still serves on a number of C.M.A. technical committees. He has also given considerable assistance to the Service Departments—particularly the Admiralty—in cable design and has a wide experience in the development of mining type cables. Mr. Parker joined the company in 1901 and served in the old Arc Lamp Department for five years, when he went to the cable department. In 1935 he took over control of the technical construction and design of rubber cables in the J. & P. laboratories.

Mr. T. B. Parker

Mr. A. C. Newby, formerly planning engineer at Charlton works, has been appointed assistant works manager (trams & trolleybuses) in the department of the chief mechanical engineer (road services) of London Transport.

Mr. T. L. Garner, M.Sc., D.I.C., of Precision Rubbers, Ltd., has been elected president of the Purchasing Officers' Association for 1951-52. The new vice-presidents include **Mr. H. H. C. Wood** of the Igranic Electric Co., Ltd. **Mr. R. J. Mitchell** of the Morgan Crucible Co., Ltd., is the hon. treasurer.

When **Sir Charles Colston,** C.B.E., chairman and managing director of Hoover, Ltd., returned recently from a six weeks' business visit to North America, he was accompanied by Mr. H. W. Hoover, Jun., assistant vice-president of the American company, who is the elder son of the present chairman of the American company, Mr. H. W. Hoover. Mr. Hoover, Junior, has been selected for training

as successor in due course to the present president of the American company, Mr. J. F. Hattersley. He will study under Sir Charles Colston the methods of the British company and its overseas associates.

Mr. J. M. Drummond, A.S.A.A.(Hons.), F.I.M.T.A., has been appointed a deputy chief accountant of the British Electricity Authority. Mr. Drummond has been city treasurer of Sheffield since September, 1948, and from 1945 was deputy city treasurer. Previously he was borough treasurer at Darlington.

Mr. R. F. Norris has relinquished his position with the oil engine division of the Brush Aboe group to become general manager of D.M.M. (Machinery), Ltd., who are the accredited English representatives of a group of German engineering firms. Mr. Norris has previously held appointments with the Metropolitan-Vickers Electrical Co., Ltd., and John Fowler & Co. (Leeds), Ltd.

We regret to hear that **Mr. S. O. Bowker** Tenby Switches, Ltd.) has been for some time in Mundesley Sanatorium, near Cromer, Norfolk, and is to undergo an operation shortly. Mr. Bowker will be pleased to see or hear from electrical friends.

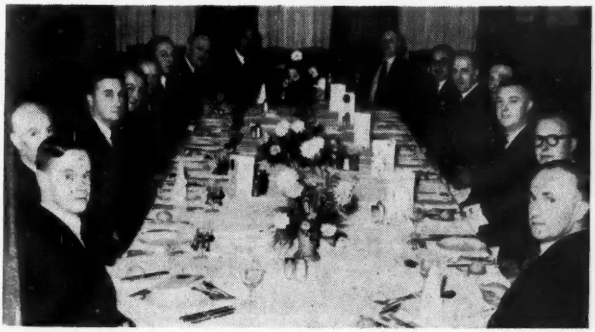
The Summer Visit of the Measurements Section of the **Institution of Electrical Engineers** took place on 22nd September. A large party of members and their ladies visited the research laboratories of Elliott Brothers (London), Ltd., at Borehamwood and the Gate Studios at Elstree during the morning and afternoon. At the laboratories, a number of working exhibits in the electrical, electronic, mechanical and hydraulic departments were on view and for those seeking lighter entertainment a film show was presented. Mr. J. F. Coales, research director, welcomed the visitors to lunch as guests of the company, and the chairman of the section, Dr. G. A. V. Sowter, responded on behalf of the visitors. Afterwards the party visited St. Albans for tea and were shown over some of the interesting places in the city by official guides provided by the National Council of Social Service.

Mr. W. B. Robson, A.M.I.E.E., has relinquished his position as head of the Publicity and Order Departments of Brookhirst Switchgear, Ltd., Chester, upon his appointment as general manager of Cantie Switches, Ltd., Bromborough, Cheshire. Mr. Robson received his early training with A. Reyrolle & Co., Ltd., Hebburn, and, following appointments with the English Electric Co., Ltd., and the Electroflo Meters Co., Ltd., he joined Brookhirst Switchgear, Ltd., in 1938. Between 1939 and 1946 he was personal assistant to the managing directors, manager of branch works, and subsequently assistant works manager.

Mr. W. B. Robson

The 70th anniversary of **Falk, Stadelmann & Co., Ltd.,** was celebrated on Friday last when a Festival dance was held at the Victoria Rooms, Southampton Row, London, at which over 300 members of the staff and their friends were present. As was befitting on such an occasion, the directorate was there in force, and included Mr. Hugo Falk (chairman) and Mrs. Falk, Mr. C. Falk and Mrs. Falk, Mr. G. Falk, Mr. W. Thurner and Mr. H. Allen. The festive spirit was much in evidence, and carnival novelties added to the gaiety of the evening, while an excellent cabaret proved very popular. There was a splendid array of prizes for " spot " and other dances and these were presented to the winners by Mrs. Hugo Falk.

To mark the retirement of **Mr. H. F. Carpenter** from the position of secretary to the British Electricity Authority, the fourteen divisional secretaries of the B.E.A. recently entertained him to dinner at the Restaurant Frascati, London, when he was presented with a pint size reproduction early Georgian silver tankard.



Divisional secretaries of the B.E.A. at the dinner given to Mr. H.F. Carpenter who is seen third from the top on the right hand side of the table

At the Dorchester, London, W., last Saturday the staff of the **Henley Organization** held their annual dinner and dance; there was a company of about 680. Sir Edward Crowe, K.C.M.G. (director), presided and Sir Montague Hughman, the chairman of the Organization was present. The speeches were brief. Sir Edward Crowe welcomed the guests and Mr. C. H. Harris (Tyre Co.) proposed the toast "The Henley Companies." He said that few concerns offered such opportunities to young people for advancement as those provided by Henley's. Sir Edward Crowe responded to the toast in a witty speech. The health of "The Ladies" was felicitously proposed by Mr. E. J. Vidler and Miss E. S. Wiseman replied. Music was provided by Arthur Salisbury and his dance orchestra and "turns" were given by The Courtneys and Spence and Davies.

On 3rd October **Sir Edward Otho Glover,** A.M.I.E.E., visited the factory of W. T. Glover & Co., Ltd., at the invitation of the general manager, Mr. D. T. Hollingsworth. Sir Edward is the surviving son of the late Walter T. Glover who, in 1868, founded the company. During the tour of the factory improvements made to the original machines invented by his father were demonstrated by the operatives. Sir Edward is not now actively connected with the company. He has been closely connected with the technical staff of Castner Kellner Alkali, Ltd., and the I.C.I., Ltd., for many years.

The High Commissioner for Pakistan, **H.E. Habid Ibrahim Rahimtoola,** and the Begum Rahimtoola recently paid a visit to the Greenwich works of the Telegraph Construction & Maintenance Co., Ltd. They were received by Mr. J. N. Dean, managing director of the company, and Mrs. Dean. We reproduce a photograph taken on the occasion.

The High Commissioner for Pakistan being greeted by Mrs. J. N. Dean at the Telcon Works

Competing against thirty-one teams at the annual tournament of the London Private Fire Brigades' Association held on 29th September, at the works of Standard Telephones & Cables, Ltd., New Southgate, the works fire brigade of the **Micanite & Insulators Co., Ltd.,** Walthamstow, won for the second time in succession the trophies for the championship of the United Kingdom and the 1st Division championship. They were also awarded the Hitchcock Shield for the two man drill and the Achille Serre cup for the five man drill.

A dinner to celebrate the silver jubilee of **E. K. Cole, Ltd.,** was held at the Savoy Hotel, London, on 2nd October. Mr. E. K. Cole presided and replied to the toast of "The Company" proposed by Sir Vincent de Ferranti. Mr. N. C. Robertson proposed the health of the guests and the response was by Sir Edward Wilshaw. The menu prepared for the occasion included four pages reproducing newspaper cuttings and photographs of some of the principal events of 1926 when the company

Mr. and Mrs. E. K. Cole with the portrait which was presented to Mr. Cole. Also in the picture is Mr. A. W. Belcher, who made the presentation

was formed. We have already referred to the presentation by the staff of his portrait by Frank O. Salisbury to Mr. Cole; we now reproduce a photograph taken at the function.

The first dance of the season organized by the **Sloan Electrical Co.'s** Social Committee was held in the Paviour's Arms, Westminster, on 21st September. Some 100 members and friends attended and dancing to Frank Charles' Orchestra continued from 7.30 to 11 p.m. The M.C. was Mr. H. Leigh, who introduced several novelty features, which added to the enjoyment of the evening.

Maj.-Gen. L. B. Nicholls, chairman of Cable & Wireless, Ltd., left London on Tuesday last for a three weeks' visit to the United States for negotiations with the chiefs of American overseas telegraph companies. He will also meet Maj.-Gen. George I. Back, chief signal officer, War Department, Washington, who was his deputy during the Italian campaign.

Mr. G. D. F. Pringle (Birmingham) has been appointed president of the Engineer Surveyors' Association for 1951-52, and **Mr. F. S. Bowen** (Manchester), vice-president.

The second reunion and annual dinner of the **Falcon Association,** which is the official link between former Brush apprentices and directors and senior members of the Brush Electrical Engineering Co., Ltd., Loughborough, was held on 28th September. The members, who had travelled from all parts of the British Isles, toured the works and learned of the developments which have taken place during the past year and were also shown the Group film "Power." At the annual general meeting Mr. J. W. C. Milligan (general manager and local director) was re-elected president. The reunion dinner was held in the evening at the Grand Hotel, Leicester, where a company of 160 members and guests were entertained. This was followed on Saturday by a Rugby match between the Falcon Association and present Apprentices' Association, and a dance in the evening at Loughborough.

OBITUARY

Dr. A. Philips.—The death occurred at Eindhoven, Holland, on 7th October, of Dr. Anton Frederik Philips, president of the board of Philips Electrical Industries, Ltd. He was seventy-seven. The great Philips factories in Eindhoven were founded in 1891, when Dr. Philips' brother, Gerard, started a small electric lamp factory. Later, Dr. Anton Philips took charge of the commercial side of the new firm and under this new arrangement, the factory started to make a profit. When, in 1922, his brother Gerard retired from business, the firm of Philips was employing 5,500 people, having its factories exclusively in Eindhoven. Now Philips is a world concern with factories in twenty-six countries, employing more than 80,000 people. During the war years, Dr Philips was at the head of the organization in the United States, which continued to conduct the affairs of the Philips concern. After the war, in which one-fifth of the factories were destroyed, reconstruction was speeded up and by the end of 1946 the 1939 production level had again been reached. Many marks of distinction were conferred upon Dr. Philips in appreciation of his work in promoting the prosperity of the Netherlands.

Mr. C. T. S. Arnett.—We regret to record the death on 3rd October of Mr. C. T. S. Arnett, O.B.E., B.Sc., M.I.E.E., M.Inst.F., whose retirement from the position of controller of the North Western Division of the British Electricity Authority was only reported in our last week's issue. Mr. Arnett was sixty-three years of age.

Mr. F. W. Lawlor.—The British Vacuum Cleaner & Engineering Co., Ltd., informs us that its Norwich branch manager, Mr. F. W. Lawlor, died suddenly on 29th September. Mr. Lawlor had been with the company since 1927, and he was district manager at Hammersmith and London area superintendent before going to Norwich.

Mr. H. W. Cox.—The death occurred on 27th September of Mr. H. W. Cox, accountant, Western Sub-Area, London Electricity Board. Before nationalization he was assistant accountant of Central London Electricity, Ltd.

Mr. W. H. Flear, property manager, secretary's department, London Electricity Board headquarters, died on the same day. He also was with Central London Electricity, Ltd., before nationalization.

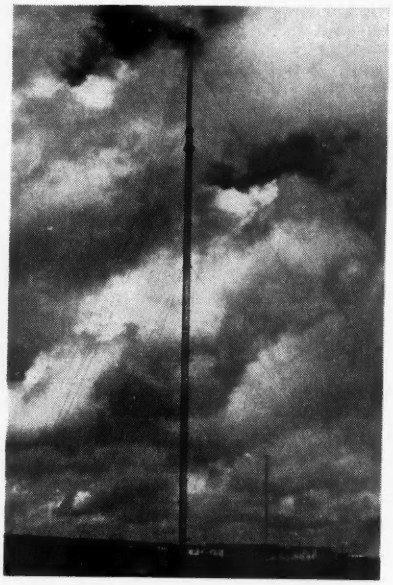
Mr. S. C. Leoni.—The death has occurred of Mr. S. C. Leoni, who was connected with the Driver-Harris organization for nearly twenty years, and was latterly director of both the Italian and French companies.

Mr. G. P. Brown, London representative for the past 32 years of Pritchett & Gold and E.P.S. Co., Ltd., died in hospital on 17th September after a long illness. He was fifty-nine years of age.

WILLS

Mr. G. W. Stubbings, B.Sc., A.M.I.E.E., F.Inst.P., of Winchester, a well-known writer on electrical subjects, who died on 14th April, left £6,391 gross (£6,290 net).

Mr. H. Coates, M.I.E.E., F.I.I.A., director of Watford Electric & Manufacturing Co., Ltd., who died on 24th May, left £15,458 gross (£14,187 net).



Above: General view of the station and aerial

Below: The main transmitter hall containing the 45 kW vision transmitter (left) and the 12 kW sound transmitter (right)

Right: Control desk for the high-power vision and sound transmitters. The control room has windows overlooking the transmitter hall so that the engineer on duty can see the transmitters

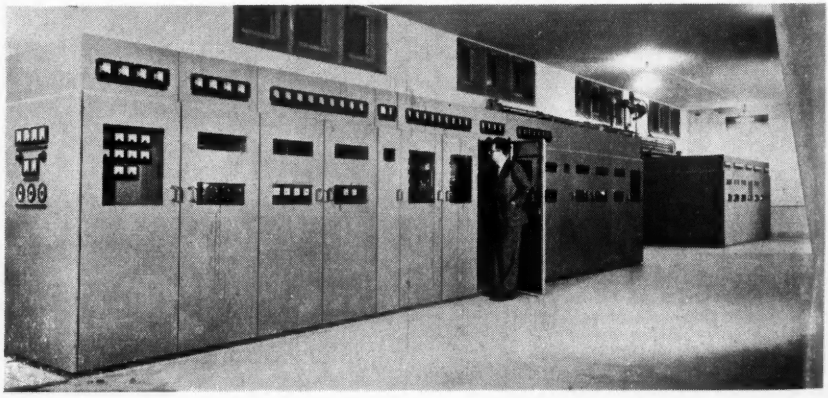
Television in the North

Holme Moss Transmitting Station

THE high-power television transmitter at Holme Moss, which is to serve the North of England, is to be put into commission to-day (Friday). It is the second high-power transmitting station to be completed under the B.B.C.'s post-war plan for extending the television service and it will bring programmes within the reach of 11 million people over and above the 18 million already served by Alexandra Palace and Sutton Coldfield.

The station is on a 150-acre site adjoining the Holmfirth-Woodhead road about eight miles to the south of Huddersfield. It comprises a building housing the two main transmitters, a smaller building for two stand-by transmitters, a 750ft mast supporting the main aerial, and a 150ft mast for the stand-by aerial. As the site is at an altitude of 1,750ft the 750ft mast brings the main aerial to a height of 2,500ft above sea level.

To be in keeping with the wild character of the moorland upon which the station has been built, the external walls have been constructed of hammer block random



rubble gritstone, with sawn facings and dressings. In plan, the main building is 'L'-shaped; one block houses the main vision and sound transmitters, the other a quality checking room, offices and a canteen. The smaller building housing the stand-by transmitters is of similar construction, but it also contains a garage and a substation.

Heating is normally provided by warm air discharged from the transmitter cooling equipment, about 150 kW being available from that source. When the transmitters are not in use "Thermovent" heaters are employed.

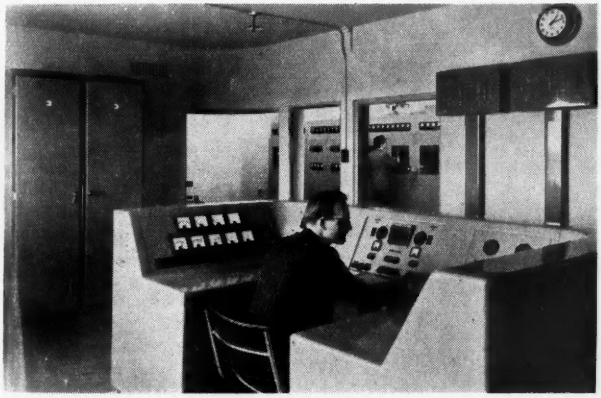
Water supplies are taken from Yatcholme Reservoir some 800ft below the site, a stone built pump-house having been constructed to accommodate two electrically driven remotely controlled high-lift pumps.

The 750ft mast has an all-up weight of 140 tons, the maximum downward thrust on the mast base under the most severe conditions being 350 tons. The base is located by a 2in diameter steel ball in a socket which forms a pivot to allow angular movement of the mast in high winds. Up to the 610ft level the cross-section is triangular, each face being 9ft across. Between 610ft and 710ft the cross-section is circular. The eight tiers of four slots in the surface of this part will form an aerial for v.h.f. sound broadcasting, should this system be adopted at Holme Moss in the future. Above the circular section is a short square-section topmast which supports the television aerial.

The transmitter block of the main building is divided longitudinally into three main areas by two partition walls. In the central area the sound and vision transmitters are arranged in line. The area bounded by the partition wall behind the transmitters and the outside wall of the building is divided into three; the centre section contains the power conversion plant for the two transmitters and the two end sections the valve cooling plant. Along the other side of the transmitter hall is the control room, flanked by the vision and sound lines termination rooms.

The vision transmitter is the most powerful in service anywhere in the world, having a peak white power of 45 kW. It is grid-modulated in the final r.f. stage and operates on a carrier frequency of 51·75 Mc/s (5·8 metres). The transmitter consists of ten cubicles with an overall length of 31ft, including a power distribution cubicle 10ft long.

The power conversion plant is in an enclosure 35ft long behind the transmitter. High-voltage supplies are obtained from hot-cathode mercury-vapour rectifiers. The phases of the 415 V a.c. supply are stabilized and phase-balanced by three separate moving-coil voltage regulators. In addition, the high-voltage d.c. supplies from which constancy of output is important are provided with shunt valve stabilizers which result in the supplies having very low output impedances. The modulator is arranged to work with a single supply of 3·5 kV at 6 A which has both positive and negative terminals insulated from earth. A stabilizer is provided to give this supply a source impedance of 0·5 ohm and an additional stabilizer results in an impedance of one-sixth of an ohm between the negative supply terminal and earth. These low source impedances are necessary because the varying r.f. stage grid current returns through this supply and because the modulator anode current varies with signal level.



The smoothing circuit associated with the anode supply to the modulated r.f. stage is designed to

have a constant resistive impedance of 67 ohms from zero frequency up to 5 Mc/s in order to give a linear modulation/frequency characteristic.

The filaments of the valves in the last three r.f. stages of the transmitter are supplied with d.c. from a motor generator set which has an electronic regulator keeping the output voltage constant to within 0·1 per cent and limiting the filament current to 110 per cent of normal when starting from cold. All the remaining valves are a.c. heated.

The sound transmitter is 15ft 6in long with a power conversion plant enclosure 14ft 3in long, and is similar to that at Sutton Coldfield. It has a carrier power of 12 kW and employs high-power "Class B" modulation with the usual negative feedback circuits, which result in total harmonic distortion figures of less than 2 per cent at levels of modulation up to 95 per cent over the normal range of modulating frequencies. The carrier noise level is better than 60 db below 100 per cent modulation.

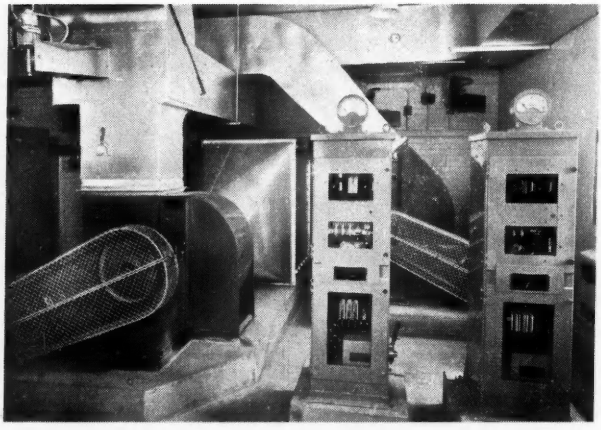
The anode and bias supplies are provided by rectifiers in the power conversion plant enclosure. All valve filaments are a.c. heated except that in the modulated output stage which is supplied with d.c. from a motor generator. This is fitted with an electronic regulator similar to the one associated with the vision transmitter.

Each transmitter has its own valve cooling plant contained in a separate room to prevent the noise of the cooling plant from reaching the rest of the transmitter area. The air from each blower can be circulated round a closed system until its temperature is raised to a suitable value and then surplus warm air may either be circulated round the building or exhausted to atmosphere. Thermostatically controlled motor driven dampers determine the path that the air follows.

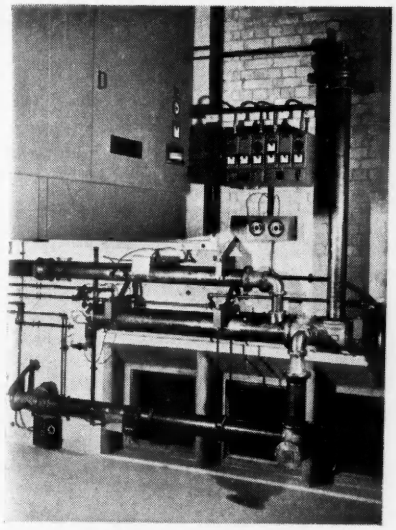
Each transmitter is provided with a water cooled test load of the dissipative line type in which the power is dissipated in the cooling water.

The vision transmitter supplies a double sideband signal to its output feeder, the upper sideband of which is attenuated in a vestigial sideband filter, connected between the transmitter output and the combining unit. The filter comprises a high-pass and a low-pass section, and is mounted on the wall behind the transmitter. The low-pass section is terminated by the 51·5 ohm feeder leading to the aerial, and the high-pass section by a water-cooled constant-resistance absorber load which dissipates about 1 kW when normal pictures are being transmitted. The lower frequency sideband is transmitted fully, but the upper sideband is increasingly attenuated for vision frequencies above 0·75 Mc/s. At 53·25 Mc/s, the carrier frequency of the sound transmitter in the adjacent channel, the attenuation introduced by the filter is approximately 12 db.

On the wall above the sound transmitter is a unit which combines the outputs from the sound and vision transmitters and feeds the combined output to the 51·5 ohm coaxial feeder leading to the aerial. To avoid cross-modulation between the transmitters, only a negligible proportion of the output power from one transmitter should reach the other. The combining unit is basically a balanced bridge circuit, with the vision and sound transmitter outputs applied to the oppo-



Cooler room for the vision transmitter



Left: Combining circuit for the high-power vision and sound transmitters below which are reflectometers for indicating the forward and backward power at various points in the system. Right: Control desk for the medium-power stand-by transmitters

site corners of the bridge. Two of the opposing arms of the bridge are formed by the load of the aerial feeder and a wide-band resistance load. The other two arms are formed by complementary networks, which present a low impedance at the vision carrier frequency and a high impedance at the sound carrier frequency and *vice versa*. The power dissipated in the resistance load under working conditions is about 300 W. At the Sutton Coldfield station the vision and sound r.f. signals are combined in a diplexer at the top of the cylindrical section of the mast. Advances in technique have now made possible the more convenient arrangement adopted at Holme Moss in which the signals are combined in the transmitter building.

A concentric feeder having an outer diameter of 5in and a characteristic impedance of 51·5 ohms carries the combined outputs of the sound and vision transmitters to the aerial at the top of the mast. The feeder is built up from 12ft sections, with an expansion joint every 150ft to accommodate changes in length resulting from temperature variations. To prevent condensation, dry air is blown into the feeder from a unit in the sound cooler room. A separate 150ft mast carries emergency sound and vision aerials. These are fed by coaxial cables of 85 ohms impedance, separate cables being used for the sound and vision aerials. Owing to the limitations of the cable, the maximum power on the emergency aerials must be restricted to 20 kW vision and 5 kW sound.

Both transmitters are operated from a single control desk in the control room. Windows between the control room and the transmitter hall afford the engineer on duty a clear view of both transmitters. The control systems of both transmitters are conventional, being sequency interlocked and operated by means of toggle switches on the control desk. The correct functioning of the various interlocks in the control circuit is indicated by lamps on panels on the wall facing the desk. Meters on the desk indicate the voltage of the various power supplies and also the anode currents of the more important valves in the transmitter.

The centre section of the desk houses a waveform monitor which can be switched to examine the output at various points in the modulator chain and also at monitoring points on the outgoing r.f. feeder. Also on the centre section of the desk are switches

which select the input signal fed to the transmitters, enabling either locally generated or line signals to be radiated. The locally generated signals normally consist of either test wave-forms or the output from one of the two monoscopes.

Two 12in picture monitors mounted side by side in front of the desk display the picture at the modulator input and as radiated, thus enabling a direct comparison to be made.

The vision signal from London travels over coaxial cable via Manchester and is demodulated by G.P.O. equipment in the fully screened vision line termination room before being passed to the vision transmitter via the control room.

The sound line termination room contains the sound line termination and test equipment, and the re-broadcast receivers. A vision receiver is fed from an aerial directed on Sutton Coldfield and mounted at the 600ft level in the mast. It will be used only in the event of a breakdown on the cable link. The pictures from this receiver have so far been free from fading and are of good quality, but occasionally suffer from slight car-ignition interference.

Installed in a room adjoining the garage are a 2 kW sound and a 5 kW vision transmitter which can be connected to the main or reserve aerials by means of switches. These transmitters are independent of the corresponding equipment in the main building.

The station has a three-phase 11 kV electricity supply from the B.E.A. through duplicate feeders terminating at switchgear in the substation. The supply is transformed down to 415 V and distributed from the l.v. switchroom in the annexe to the transmitters and to the l.v. switchroom in the main building which contains the distribution switchgear for the auxiliary services. Two 500 kVA transformers are provided, one being a spare. The transmitter control circuits are provided with a 50 V supply from metal rectifiers and a 240 V battery supplies the emergency lighting system.

The vision signals radiated from Holme Moss conform to the standards adopted for the British Television Service, i.e., twenty-five 405-line pictures per second, each composed of two interlaced frames of 202½ lines. The quality of the pictures transmitted is not impaired by the cable links between Alexandra Palace and Holme Moss, and viewers in the area can count on entertainment in every respect equal to that enjoyed by viewers in the London area.

The principal contractors for the station were Marconi's Wireless Telegraph Co., Ltd., main and stand-by vision and sound transmitters and associated equipment; Brush Electrical Engineering Co., Ltd., main l.v. switchgear and 11 kV/415 V transformers; Standard Telephones & Cables, Ltd., auxiliary l.v. switchgear; S. Dickinson, Ltd., emergency lighting battery; Rosser & Russell, Ltd., valve cooling and ventilation; A. E. Sudlow Ltd., screening of l.v. room; Telegraph Construction & Maintenance Co., Ltd., coaxial cables to reserve masts; British Insulated Callender's Construction Co., Ltd., mast; John Laing & Son, Ltd., roads and buildings. The contractors to the G.P.O. for the programme links were Standard Telephones & Cables, Ltd., coaxial cables and translating equipment; and the General Electric Co., Ltd., amplifiers.

The G.P.O. was responsible for the installation and overall line-up of the links and also for the design and manufacture of the control equipment.

Nickel-Chromium Alloys

A 40 pp. publication issued by Henry Wiggin & Co., Ltd., Wiggin Street, Birmingham, presents, in a convenient form, all the available information on the "Nimonic" series of alloys. There are tables of physical and mechanical properties and a useful series of graphs giving design data of these nickel-chromium alloys at various temperatures; in this section appear some data only recently determined as a result of the long-time creep testing which is still in progress. Other sections summarize heat-treatment and acceptance creep tests while a list of typical applications shows that these alloys, in addition to their use as the standard creep-resisting material for gas turbine blades, have a wide field of application for many other components operating at elevated temperatures.

Power System Calculations

AN advanced course of seven lectures on "Power System Calculations," will be given on Saturday mornings, commencing on 20th October, at the Heriot-Watt College, Edinburgh. The fee for the course will be £2 2s and particulars can be obtained from the secretary of the College.

Steam Turbines

*Revised British Standard**

MOST of the modifications to the British Standard Specification for Steam Turbines (B.S. 132), which was last issued in 1930, relate to larger units, as installed in power stations, though the general requirements of smaller machines are covered.

A table of recommended outputs and steam conditions for 10, 20, 30, 60 and 100 MW (maximum continuous ratings) is included without reference to speeds. For the smallest size the steam pressure and temperature at the turbine stop valve are 400 lb/sq in and 800 deg F with a maximum feed water temperature of 300 and with 3 or 4 extraction points. The requirements for 20 MW may be the same as for either the 10 MW or the 30 MW sets, the latter working at 600 lb/sq in and 850 deg F with feed water at 335 deg and 4 or 5 extraction points. Corresponding particulars for the 60 MW machines are 900 lb/sq in and 900 deg, 375 deg and 5 or 6 bleeding points, and for those of 100 MW rating 1,500 lb/sq in and 1,050 deg, 410 deg and 6 points. In every case the maximum feed-water temperature is subject to a margin of ± 10 deg. For 10 and 20 MW sets lower feed water temperatures may be adopted by reducing the number of feed heaters and blanking off the appropriate tapping points.

Pressure and Temperature Limits

Vacuum at most economical output in all cases is prescribed at 0·49 lb/sq in (1 in Hg) absolute or 0·93 lb/sq in (1·9 in Hg) absolute. Abnormal pressure swings, up to 120 per cent of rated value, should not exceed twelve hours in all during any twelve months of operation. Abnormal temperature swings should not be more than 25 deg above the rated value for aggregate operating periods up to 400 hours in twelve months or 50 deg for 15 minute fluctuations aggregating not more than 80 hours. These limits are tentative pending further experience.

The most economical rating is preferably either 100 or 80 per cent of full output. Permanent speed variation from no load to full load must not exceed 4 per cent and the maximum variation shall not be enough to operate the emergency governor (viz. 10 ± 1 per cent). No-load speed shall be adjustable by ± 6 per cent. An overspeed test for no longer than five minutes may be made but only during the acceptance trial and shall not be for more than 15 per cent above normal speed.

Steam (or heat) consumption per kWh may be obtained either for one specified load or for a series of loads in accordance with a stated equation. Tolerance is normally $\pm 2\frac{1}{2}$ per cent. Temperature of oil on leaving bearings should not exceed 160 deg F. Cast iron shall be used only for turbine parts subject to temperatures of 450 deg F or below. The critical speed of the rotor shall not be within ± 20 per cent of normal speed. Supervising equipment, if required for machines above 30 MW, shall include precision instruments to indicate and record high pressure shaft eccentricity and expansion of the high pressure shaft in relation to the high pressure casing.

Non-condensing Operation

Condensing turbines of over 3 MW shall not be required to work non-condensing. When 3 MW or smaller units are arranged for non-condensing operation, they shall be capable of giving 30 per cent of rated output at rated speed and steam conditions, provided steam pressure is not less than 150 lb/sq in. The exhaust steam temperature, however, must not exceed 300 deg F and the output shall be limited accordingly. Turbines of 30 MW and over are desirably equipped with devices for reducing steam admission automatically with falling vacuum and for tripping the emergency stop valve and disconnecting the generator from the system should the vacuum fall further to a predetermined limit.

* B.S. 132 : 1951, British Standards Institution, 24, Victoria Street, London, S.W.1, price 2s post free.

Claim Against E.T.U.

IN the Chancery Division last week Mr. Justice Wynn-Parry heard an application from seven members of the Electrical Trades Union for declarations that the strike earlier this year of electricians employed by the London Electricity Board was illegal, that its conduct was not in accordance with the Union's rules and that they were entitled to the rights and benefits of membership. They also sought injunctions restraining the Union from expelling or otherwise penalizing them for their refusal to take part in the strike. The defendants were the Union, its general secretary (Mr. W. C. Stevens) and a number of officials, including Mr. A. Stride who was said to have been responsible for handling the strike; they all denied threatening the plaintiffs and claimed that they acted according to the rules of the Union.

Mr. D. Gerrard, who appeared for the plaintiffs, told the Court that the strike began at the Bethnal Green depot of the London Electricity Board and spread until it involved 2,000 men. The cause of the strike was the promotion to electrician's mate of a member of the Transport and General Workers' Union. When the plaintiffs refused to strike pressure was put on them; five were threatened with expulsion, another was proceeded against by his branch but the branch committee failed to agree, and the sixth was fined £20. Mr. Gerrard said that the general secretary and assistant secretary were the real organizers of the strike, which, he alleged contravened S.R. & O. No. 1305, while Mr. Stride "fomented and increased" it. The London Electricity Board was giving financial assistance to the plaintiffs. He understood that £50,000 had been disbursed by the Union in strike pay.

Mr. Justice Wynn-Parry considered that as the strike was now over he did not see what would be gained by proceeding with the action. For the Union, Mr. K. Diplock, K.C., said his clients were prepared to stand by an understanding that had been made that there would be no victimization but Mr. Gerrard said that such an undertaking by itself was not acceptable to the plaintiffs.

Evidence was given by Mr. R. J. Simmonds, one of the plaintiffs, to the effect that he had asked Mr. Stride for something in writing to show that the strike was "official" but he was evasive. They decided to remain at work and sent a telegram to the Union's headquarters asking for confirmation that the strike was official but no reply was received. Witness said that the Union was Communist-dominated and they could not accept anything from it unless it was in writing.

Further evidence was given by the other plaintiffs and on Friday last Mr. Diplock opened the case for the defence. He reviewed the history and rules of the Union and said that those rules were applicable to all members whether they were Communists or not. He submitted that the promotion of a member of another union struck at the root of the principle for which the E.T.U. had fought for years, that it should have sole negotiating rights for all electricians in the electrical contracting industry.

The hearing was adjourned.

Power Shortage in Israel

SEVERE restrictions on the use of electricity have just been introduced in Israel by the Palestine Electric Corporation because of the increased load. The two main factors responsible for this situation are the housing of almost 1,000 new immigrants every day, and the use of electricity for irrigation in the country's extensive citrus groves.

From sunset to 9.30 p.m. on Sundays to Thursdays inclusive, the use of electricity for lighting is permitted within the following load limits only:—

Not exceeding 100 W in any one room, and not exceeding 60 W in any kitchen, balcony or other service room in the home. Such wattages may not be exceeded in any one room—even if lamps are not being used in other rooms. There are no restrictions on electric lighting after 9.30 p.m.

The use of cooking, baking and heating appliances (electric cookers, cooking plates, saucepans, kettles, coffee roasters) on all weekdays is permitted only before 7 a.m., between 12.30 and 6.30 p.m., and after 9.30 p.m. Refrigerators, radio sets, electric irons, washing machines, vacuum cleaners and electro-therapy apparatus are exempt from all restrictions. Storage water heaters may be used only between 10 p.m. and 6 a.m. Although there are no official restrictions on the use of electric irons, the company has requested consumers where possible to use them only between 6.30 and 9.30 p.m.

As far as shops are concerned, the order states that from Sundays to Thursdays inclusive, electricity may be used only after 9.30 p.m. for advertising and for the lighting of shop windows, arcades and building façades. The Palestine Electric Corporation believes that the restrictions may have to remain in force for about six weeks. The position worsened when a 12,000 kW generator at the Corporation's main power house at Tel Aviv broke down and more drastic measures to curtail consumption may become necessary.

The new order does not apply to the city of Jerusalem where the Jerusalem Electric and Public Service Corporation is responsible for the supply of power, but this company has also issued a warning to its consumers and restrictions are expected to be introduced in the city in the near future.

Modern Magnetic Materials

I.E.E. North-Western Centre Chairman's Address

FACTORS which influence the design of electromagnetic equipment were commented on last week by Mr. G. R. Polgreen (Salford Electrical Instruments, Ltd.) in his inaugural address at Manchester as the new chairman of the North-Western Centre of the Institution of Electrical Engineers.

Mr. Polgreen said that electromagnetic products, such as electrical machines, instruments, etc., seemed to have reached the degrees of uniformity which occurred in all manufacturing activities until new discoveries or techniques appeared, altering the whole basis of design and manufacture. The address was an attempt to answer the question whether such a stage had been reached in electrical engineering as a result of recent developments and discoveries principally in magnetic materials and insulating substances.

Search for Substitutes

The speaker mentioned the effects of the present severe shortage of non-ferrous metals. More acute shortages had occurred in other countries and in some cases the search for substitutes had resulted in new discoveries. These were considered from the aspects of improved material properties, more efficient designs and new manufacturing processes. Some new developments described were suggested or even patented by the pioneers of electrical engineering, but they had neither the materials nor the techniques to convert their ideas into practical use.

To examine the extent to which the design and performance of present-day electromagnetic products, particularly those used for small power applications, depended on the limitations of available materials, Mr. Polgreen compared them with a hypothetical ideal.

Recent work, particularly in the sphere of moulded magnetic materials, enabled this ideal to be achieved to a considerable extent. It was now possible to make both low loss and permanent magnet materials with very high values of specific resistance, either from non-metallic magnetic materials or from composite cores of metallic powders which were insulated and compressed at high pressures. These materials could be moulded, by automatic or semi-automatic methods, into solid blocks of optimum design for high efficiency and low leakage field, and a large proportion of the total requirements could be provided with pure iron made from one of the few raw materials available in this country.

Use of Ferrites

Mr. Polgreen then described these developments in detail and said that because of the importance attached to the reduction of eddy current loss he chose the subdivision of metals as the first subject for consideration. This was followed by a brief description of the recent improvements in non-metallic magnetic materials, which are generally known as ferrites, in the production of permanent magnets from very fine powder, and the insulation of copper conductors. This led to an examination of the new designs which these materials made possible, and the manufacturing methods associated with them. Some examples of new instruments and components using the new materials and techniques were also mentioned.

The practical applications of high flux density powder cores and micropowder magnets were at present limited because they were very recent developments. However, both materials were similar in structure to the iron powder cores used successfully in large quantities during the last twenty years and sufficient experience had been obtained to show that they possessed the same merits of high stability and permanence. By using them together in composite structures, they could provide an efficient method of concentrating the magnetic flux, which had hitherto presented a problem in using magnets with high coercive force and limited remanence values.

If both low loss core and micropowder magnets were made of iron powders moulded into electromagnetic products of

efficient shapes, they could provide a direct saving of such scarce metals as nickel and cobalt and indirectly afford a saving of copper because of the improved design. Permanent magnets possessed the advantages that they provided magnetic flux without the use of external energy, did not generate heat and avoided the necessity of additional windings, and so there were many possibilities of extending their practical applications if they could be manufactured economically and efficiently. The manufacture of moulded magnetic materials required large presses, complex equipment and tool making of high quality; thus it was necessary to make large quantities of a standard design to obtain economic production. These conditions now applied to a wide range of the smaller electromagnetic products, so the technical promise of these new developments gave future prospects of practical achievement.

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Alternator Demagnetization

REFERRING to the article in your issue of 31st August on the demagnetization of large alternators, the statement that the opening of the field circuit in emergency would be disastrous must have been read with some surprise by many engineers who are accustomed to consider this the normal way to de-energize a machine. In the instance quoted by Dr. Wall there must have been some other factor which prevented the opening of the field breaker, possibly a failure of the control wiring as a result of the fire. It would appear that he has overlooked the presence of a secondary damping circuit on the rotor, closely coupled with the exciting winding, which will prevent the induction of unduly high voltages in the latter when opening the field switch, even if no discharge resistance is provided.

The method of demagnetization proposed by Dr. Wall requires a rotating d.c. machine subject to high acceleration torques and sudden applications of armature current (possibly of the order of several thousand amperes under fault conditions) which must involve appreciable maintenance. In practice, therefore, it can hardly be claimed as being more simple than the usual field breaker, with or without a discharge resistance, an arrangement which has been proved by very wide application.

With regard to the efficacy of the method, it is not clear whether the demagnetization time quoted in the last paragraph of the article is a test or calculated figure; if the latter, it must be appreciated that in general the maximum rate of decay of alternator flux will be limited by the rotor damping circuit previously mentioned and equal, if not better, performance should be obtained with a plain break-field switch. Furthermore, the time by itself is of little value as it is profoundly affected by the condition of the stator windings; with a fault on these, the time may be only 10 to 20 per cent of that with the windings sound and on open circuit.

Birmingham. V. EASTON.

Floating Power Stations

THE article on floating power stations in the *Electrical Review* of 28th September refers to the American vessel *Seapower* and gives a few details. A point of particular interest which is not mentioned is that the 30 MW generator in that vessel is hydrogen cooled, enabling a large output to be obtained from a comparatively small machine.

Thornton Heath, Surrey. L. C. ROBERTS.

Mechanical Handling Exhibition

THE third Mechanical Handling Exhibition and Convention to be organized in Great Britain are to be held at Olympia, London, from 4th to 14th June, 1952. The Exhibition will occupy about 250,000 sq ft and there will be nearly 200 exhibitors. About twelve papers by specialists will be read during the Convention. The Exhibition and Convention are organized by *Mechanical Handling* (Associated Iliffe Press, Dorset House, Stamford Street, S.E.1) with the support of the various trade associations.

Telecommunications

Developments in the Midlands

WAYS in which telecommunication advances have come about in the Midlands were outlined by Mr. W. H. Brent (G.P.O., Birmingham) in his address at Birmingham as the new chairman of the I.E.E. South Midland Centre.

The address showed how progress had taken place, first, in administration by the advent of regionalization; secondly, in telegraphy by improved methods being tried out initially in the Midland Region as, for example, the introduction of automatic telegraph switching in 1950; thirdly, developments in telephony were referred to, indicating that Birmingham would again be involved early in the programme of mechanization of the trunk service.

Long-distance Transmission

Finally, transmission problems were dealt with, in which connection the chairman's Region had been fortunate in that new methods of long-distance transmission had nearly always been introduced between London and Birmingham from the time in 1897 when the first main underground cable was laid in this country to the recent wide-band coaxial work in connection both with telephony and television.

Into the short time at his disposal the chairman compressed the developments of the past seventy years, or more. The "fourth dimension" was an essential part of all telecommunications work. They dealt in man-hours when they considered the time of the limited number of men on the staff and the limited number of new subscribers that could humanly be connected. They dealt in years, when they set forth on projects requiring buildings full of equipment for the mechanization of the trunk operating service which would take at least ten years to reach fruition. The operating staff critically watched the seconds when setting up connections, since they were unchargeable; non-conversational time and the efficiency of use of the circuits was the ratio of effective conversation time to the total. Mechanical switching could therefore reduce inefficiency in this direction to the minimum.

For the communication engineer to progress he must strive to construct devices to measure time in millimicroseconds and then to control minute amounts of energy by devices of extreme quickness of appreciation. For example, in a pulse modulation system of the time-division-multiplex type the voice variations in a channel intended to convey frequencies up to 4,000 c/s (good quality speech) must be sampled 8,000 times in a second (i.e., every 125 microseconds) and in this period of time he might want to arrange, in precise order, the samplings of, say, 12 separate channels, so he must switch the main link from one channel to the next approximately every 10 microseconds. To visualize this small element of time one could say that it was the time taken by the spot in a T.V. set to move $\frac{3}{4}$in. If the sample had to be coded in the binary code at least seven pulses must be transmitted in this interval of time and, in the summation, 672,000 bits of information must be passed every second for a 12-channel group.

Trend of Research

Why did communication engineers play with time in this fashion? One reason was given in an important foreword to the I.E.E. *Journal* of November, 1950, where it was shown that one could now see possibilities of increasing the capacity of transmission systems to a theoretical maximum dependent upon the prescribed bandwidth and the signal-to-noise ratio. Another was that expensive quartz crystals needed for the familiar frequency-multiplex system used in present coaxial cables might reasonably be displaced by electronic devices and terminal equipment costs reduced. Yet another was the ease with which signals could be "cleaned up" at intermediate points and a good ratio of signal to noise maintained over very long circuits.

In fact, research in the Post Office and elsewhere was pushing on apace with the evident object of rendering present coaxial terminal equipment obsolete. It was probable that telecommunication progress would be once more exemplified in the Midlands

by one of these new multiplex systems being applied as an experiment to the radio link which terminated on Telephone House, and that this would be the forerunner of systems whereby routes between neighbouring towns within "visual" range might be carried by v.h.f. radio links. Thus the transmission lines of fifty years ago when one conversation at a time passed over a two-wire heavy copper line with the minimum of a transmitter and receiver at the ends would be completely reversed in conception and many conversations would pass between complicated terminal apparatus without any material connection between them.

The Scarcroft Case

Defendants Committed for Trial

ON Wednesday last week the hearing was continued by the West Riding magistrates at Leeds of the twenty-four summonses against the Yorkshire Electricity Board, its chairman (Col. W. M. Lapper) and its deputy-chairman (Mr. F. Newey). The charges were that work was carried out by the Board at its headquarters at Scarcroft, nr. Leeds, and at its premises at Bramhope £41,000 in excess of the amount authorized, and the chairman and deputy-chairman were charged with aiding and abetting.

Questioned by Mr. Rawdon Smith (appearing with the Hon. R. Cumming-Bruce for the Director of Public Prosecutions) Mr. G. A. Farthing, assistant in the Board's commercial department, said that about August, 1949 he received instructions to arrange for the duplication of the electric storage heating system at Scarcroft. At later "progress" meetings it was decided to install panel heating in the extension, subject to Mr. Newey's approval, and to install an electric clock system which cost, with the wiring, about £530. Television was also provided for.

He had nothing to do with negotiations for the authorization of this work; his instructions came from the chief commercial officer.

Cross-examined by Mr. W. R. Hargrave (for Mr. Newey) the witness agreed that the work should not have proceeded without authorization. He did not know who should have applied for this and did not inquire. He told Mr. Withers Payne (appearing for the Board) that he had not taken any steps to ascertain whether authority had been obtained for the work before he asked Mr. Newey to sign letters accepting estimates.

In evidence, Mr. A. W. Lang, clerk of works at Scarcroft, said that he received instructions from time to time from Mr. Appleyard (architect), Mr. Cash (the chairman's personal assistant) and Mr. Newey. The chairman visited the job about three times and expressed certain wishes.

Evidence was also given by Mr. G. W. Warrilow, master builder, who carried out the work at Scarcroft, and Mr. C. Ovenden, representative of the heating engineers, who said that he had never been concerned with such an expensive system as a combination of thermal storage and panel heating. He agreed that the installation would save 25 per cent in fuel.

Mr. Van Ham, chief accountant to the Board, questioned by Mr. Cumming-Bruce, said that he and his department had no responsibility for applying for authorization of any of the work. Up to the time of Ministry of Fuel and Power inquiries he had had no instructions to distinguish between authorizable and non-authorizable work and nobody had approached him for figures for the purpose of application for supplementary authorization.

Replying to questions by Mr. Hargrave, Mr. Van Ham said that at a meeting of the Board on 14th February, 1950, expenditure totalling £50,150 was approved in respect of building extensions which included non-authorizable work. On 28th June, 1950, the amount expended on various building schemes was £88,000 of which £65,700 was spent at Scarcroft, including the thermal storage heating plant. The matter did not require any specific authority. The difference between the figures was regarded as chargeable to revenue. That was why the excess was not brought to the Board's notice.

Answering Mr. Cumming-Bruce, the witness said that he was given a great measure of freedom so far as the functional control of his department was concerned. With regard to the expenditure incurred at Scarcroft during the year ended 31st March, 1950, he could not say precisely when an independent firm of accountants was brought in to scrutinize the accounts, but an interim audit was carried out during the year.

Evidence was then given by the chief inspector of the West Riding Police who had attended a meeting of the Board and told the members that he was submitting a report to the Director of Public Prosecutions with a view to the institution of proceedings. He also mentioned subsequent interviews with Col. Lapper and Mr. Newey and the serving of the summonses.

All the defendants pleaded not guilty and reserved their respective defences. They were then committed for trial at the next Leeds Assizes.

Commerce and Industry

Load Spreading in Cable Industry

Scenes Filmed in Power Station

AT its meeting held on 22nd August, the Joint Industrial Council for the Electrical Cable Making Industry reaffirmed in respect of the winter months of 1951–52 the terms of the agreement on arrangements for spreading the industrial electrical load, originally adopted on 23rd September, 1947, and decided that this agreement should remain in force until rescinded by the Council or until terminated by either side giving three months' notice.

Strike at Shipbuilders

Sixty electricians employed by Bartram & Sons, Sunderland shipbuilders, who were on strike some weeks ago for higher wages, have again stopped work, alleging victimization of two members of the strike committee. It is understood about 30 employees from several grades of workers were paid off, including six electricians. Two of the last-named were members of the strike committee and the electricians alleged that this was victimization. This has been emphatically denied by the firm, which has refused to discuss the matter with the strikers while the stoppage lasts.

Unusual Activities at Battersea

Battersea power station is the scene of some exciting "shots" in the film "High Treason," a Paul Soskin production directed by Roy Boulting at Pinewood Studios. In the story Scotland Yard uncovers a conspiracy to destroy the station and security forces are mobilized to foil the saboteurs' intentions. There is a battle between the destroyers and the police, aided by troops, depicted in the "still" reproduced herewith by courtesy of the J. Arthur Rank Organization.

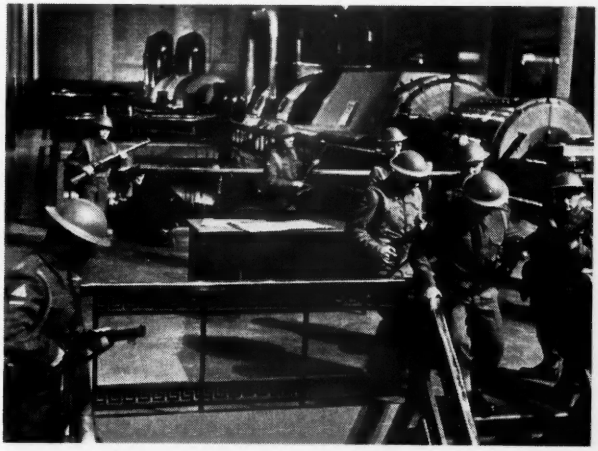
Permission was obtained to use Battersea for the film because there was no film studio in England big enough for a "set" of this size—apart from the cost which would have been involved in a reproduction of the station.

Lead Scrap Prices Reduced

Following the recent decrease in the price of lead, the Minister of Supply has made the Non-Ferrous Metals Prices (No. 8) Order (S.I. 1951 No. 1793) reducing the price of re-melted lead and lead scrap by £5 per ton. The new prices are:—Re-melted lead, £160 per ton; scrap cable sheathing, £160 per ton; lead scrap other than cable sheathing, £156 per ton. The new Order came into force on 8th October

History of Storage Battery

At a chemical exhibition, staged by eight large industrial companies in the north-west, held in Manchester's Civic Centre on 27th September to mark this year's Dalton Lecture of the Royal Institute of Chemistry, Chloride Batteries, Ltd., had a display showing the development of the lead-acid storage battery. This display traced the course of progress from Volta's pile constructed at the beginning of the nineteenth century to the large scale production to-day of electric storage batteries for a variety

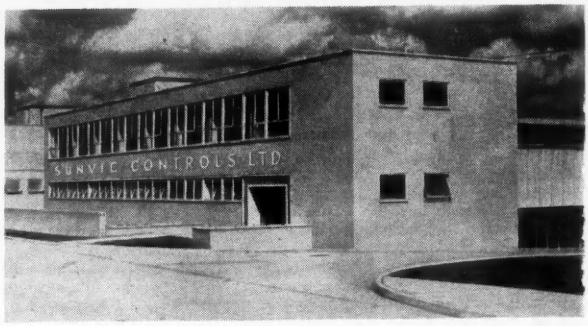


"Troops" at Battersea power station seeking out saboteurs in the film "High Treason"

of specialized duties. The successive stages in this long history were illustrated by models or actual examples of typical plates and cells from each period.

Sunvic Factory at Harlow

Sunvic Controls, Ltd., has acquired a new factory on the industrial estate at Harlow New Town. The works and offices previously at 132/135, Long Acre, London, W.C.2, have been moved to Harlow, where production has already commenced. The sales department is now situated at 132/135, Long Acre. The registered office remains at Sunvic House, 10, Essex Street, Strand, London, W.C.2.



Sunvic factory at Harlow New Town

E.C.A. – Board Conference

It has been found necessary to postpone the joint conference and dinner arranged for 25th October by the liaison committee of the Electrical Contractors' Association and the South Wales Electricity Board. The new date is 6th December; the arrangements will be similar.

Works Visits

A delegation of American industrialists, headed by Mr. E. V. Givens and Mr. C. V. Schelke, vice-presidents of the International General Electric Co., is visiting this country to see at first hand something of the methods of production in the British engineering industry, particularly in the field of heavy electrical plant. On 1st October the delegation spent a day touring the British Thomson-Houston Co.'s Rugby Works with Mr. E. H. Ball (managing director), Mr. W. W. Vinsen (director of manufacture), Mr. H. L. Satchell (director and manager, Rugby Works) and other senior executives of the company. The tour embraced the turbine, gear, heavy electrical plant, large transformer, rectifier, fabrication, motor, control gear, and industrial electronics factories, and also the research laboratory and the apprentice department. Products of other B.T.H. factories, notably electrical equipment for aircraft and cinema projectors, were also inspected. A visit to Coton House, the B.T.H. apprentice hostel, provided a less strenuous interlude in a busy day.

On 18th September, city councillors of Odense, Denmark, and councillors of St. Albans visited the Longacres factory of Marconi

American industrialists at the B.T.H. Rugby Works

Left to right: Messrs. T. A. Holme (consultant, fabrication factory, B.T.H.), M. J. Hamner (International G.E. Co., U.S.A.), E. T. Muston (superintendent, fabrication factory, B.T.H.), B. R. Sankey (I.G.E. Co., London), V. C. H. Creer, C. V. Schelke (I.G.E. Co., U.S.A.), E. H. Ball (B.T.H.), E. V. Givens (I.G.E. Co., U.S.A.), H. Boyd Brown (A.E.I.), C. A. Salmonson (G.E. Co., U.S.A.), A. K. Bushman (G.E. Co., U.S.A.), F. K. McCune (G.E. Co., U.S.A.), H. L. Satchell (B.T.H.), W. W. Vinsen (B.T.H.), H. Dreghorn (B.T.H.) and K. R. Hopkirk (B.T.H.)

Instruments, Ltd., having first made a brief tour of the Marconi permanent housing estate in the district. Mr. J. M. Furnival, general manager of the company and members of the senior staff welcomed the councillors. In the factory special demonstrations were given of deep therapy X-ray equipment and a complete assembly of diagnostic X-ray apparatus. Speakers at a subsequent luncheon included Sir Edward Crowe, a director of Marconi Instruments.

Inspection Methods

Under the auspices of the Anglo-American Council on Productivity a team left for the United States this week to study methods of inspection in practice in American factories engaged in mass production. Among the members of the team are Dr. J. Barnett, technical manager and chief inspector, Thorn Electrical Industries, Ltd.; Mr. C. H. Johnson, chief inspector, Hoover, Ltd.; and Mr. P. R. Snadden, inspector, British Thomson-Houston Co., Ltd.

L.D.C. Sales Conference

Frankness was the keynote of the discussions which took place at the sales conference of Lancashire Dynamo & Crypto (Mfg.), Ltd., held at Droitwich Spa during the last week-end in September. A very full programme gave opportunity not only for representatives from associated companies in the Lancashire Dynamo group to give some account of the individual activity of those companies in relation to L.D.C. (Mfg.), Ltd., but also presented an occasion for invaluable question-and-answer sessions and many informal discussion groups. After the opening dinner Mr. F. H. Schroeder, sales director of L.D.C. (Mfg.), Ltd., and conference chairman, spoke on the L.D.C. sales organization.

Lamp Publicity

Ekco-Ensign Electric, Ltd., think that they are probably the first lamp manufacturers to link their publicity with the General Election. A new design for their advertising depicts a figure evolved from an electric lamp with a rosette and striped trousers. The inscription is "Put me in—I'll brighten up the House!"

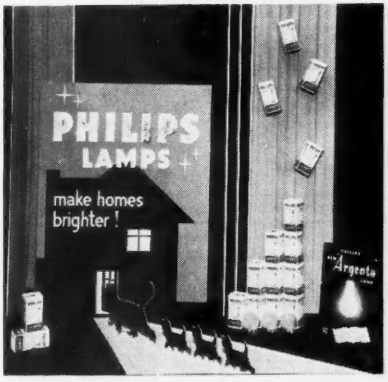
As part of their campaign for promoting the sales of "Atlas" lamps, Thorn Electrical Industries, Ltd., have prepared a cut-out sales aid displaying various types of lamps. A new pictorial advertisement has the familiar slogan "All the better to see with."

Philips Electrical, Ltd., are extending their successful lamp publicity in the London Tube Railways with a 16-sheet outdoor poster campaign in the provinces. The slogan of the poster is "Philips Lamps Make Homes Brighter" and the design, in black and yellow, is similar to the "cat" poster which has been so successful on the Underground.

The same theme is continued in their new window display incorporating amusing cut-outs of three kittens and a cat. A very effective display is the "press and compare" unit for counter use, which enables customers to see for themselves the difference between the normal pearl and the new Philips "Argenta" silica coated lamps. A useful sales aid for the dealer is the hand-with-lamp cut-out, provided with two pins, so that it can be easily pressed into the side of the door, or other suitable places in the shop. Other items include an infra-red lamp showcard for use at one-day agricultural shows, young farmers' rallies, etc., which is intended to popularize the use of infra-red lamps in rearing piglets and chicks, and the new "Photoflux" flashbulb display cut-out. A new departure is a separate catalogue for

New "Atlas" lamp cut-out sales aid

"Cat and kittens" window display of Philips Electrical, Ltd.



special lamps, including projector and floodlighting lamps, "Photoflux" flashbulbs and other photographic lamps.

Motor Coach Trains for India

The new electric rolling stock supplied by the English Electric Co. for operation on the Great Indian Peninsula Railway was inaugurated on 3rd September. The official opening ceremony was presided over by Doctor Tivraj Mehta, Minister, Public Works Department, Bombay Government. This motor coach stock is operated in 4-coach units, each made up of two 1,500 V motor coaches of 700 h.p., and two non-driving trailer coaches.

The need to operate the trains over flooded tracks during the monsoon season necessitated special features in design, and the trains are capable of running through flood water 8in above the rails at speeds up to 5 m.p.h., the traction equipment being waterproofed to a height of 30in above rail level. The units supplied on this order are to augment services which are already in operation with equipment supplied by the English Electric Co. in 1928.

The manufacturers of the motor coaches are the Metropolitan-Cammell Carriage & Wagon Co., Ltd., whose associates in India are Vickers (Eastern), Ltd. Trailer coaches were manufactured by the Birmingham Carriage & Wagon Co., Ltd., and the electrical equipment is being supplied by the English Electric Co. and the British Thomson Houston Co., Ltd.

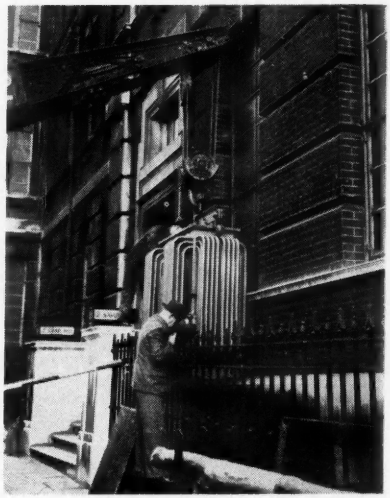
Prices of Materials

In the accompanying table we give the prices of the more important materials used in the electrical industry. The figures are those quoted on Monday last.

ALUMINIUM Ingots	ton £124 0s 0d
COPPER, H.C. Electro	ton £227 0s 0d
Fire Refined 99·7 per cent ..	ton £226 0s 0d
Fire Refined 99·2 per cent ..	ton £225 10s 0d
COPPER Tubes	lb 2s 2d
Sheet	ton £277 10s 0d
H.C. wire and strip	ton £254 0s 0d
LEAD, English	ton £176 10s 0d
Foreign	ton £175 0s 0d
MERCURY	flask £73 10s 0d
TIN	ton £1,007 0s 0d
ZINC, G.O.B. Foreign	ton £190 0s 0d
Electrolytic	ton £194 0s 0d
BRASS Tubes	lb 2s 1d
Sheet	lb 2s 4¾d
Wire	lb 2s 7¼d
PHOSPHOR BRONZE	
Wire	lb 3s 6¾d
RUBBER, No. 1 R.S.S. spot ..	lb 45½d–46d

Transformer for I.E.E. Building

The accompanying picture shows an English Electric 500 kVA transformer being lowered into a substation at the Institution of Electrical Engineers in London, and indicates the difficulty of installing substation transformers in existing buildings. To overcome this problem the English Electric Co., Ltd., at the request of the London Electricity Board, has developed substation transformers whose overall size has been reduced to the minimum. These transformers, which have been designed on the low-loss principle, for the highest efficiency, are rated at 500 kVA for use in the Metropolitan area.



Lowering an English Electric transformer into a substation in the building of the I.E.E. in London

Trade Announcement

Philips Electrical, Ltd., has opened a new depot for lamps and lighting equipment, including a small showroom, at 21/23, Hope Street, Hanley, Stoke-on-Trent (telephone: Stoke-on-Trent 2532). The premises are under the supervision of Mr. F. E. Williams.

Marconi Television

A handsome well-illustrated publication on the contributions of Marconi and the company to the inception and progress of television has been produced by Marconi's Wireless Telegraph Co., Ltd. The pictures are particularly interesting as tracing the stages by which television has reached its present advanced stage. The history culminates in the opening of the Holme Moss station, the equipment for which was supplied by Marconi's.

Y.E.B. Sheffield Demonstration Theatre

The Yorkshire Electricity Board No. 3 (Sheffield) Sub-Area opened a new demonstration theatre, at Channing Hall, Surrey Street, Sheffield, on 8th October.

The Electro-Plating Industry

Its Origins and Growth

By R. ROBERT

THE story of electro-plating starts with the appearance, in the year 1800, of the voltaic pile, by means of which the first feeble direct current was produced. The second step was taken when a Birmingham surgeon, John Wright, made the discovery that a current from a voltaic battery, passed through a solution of silver cyanide in cyanide of potassium, could be used to deposit a coating of silver on a cathode. It was left to another man, with the organizing ability of the old-time *entrepreneur*, to exploit the commercial possibilities of electro-plating, and to make it the basis of a new and highly profitable industry. This was George Richards Elkington, born in Birmingham on 17th October, 1801, a hundred and fifty years ago.

Pre-Electrical Methods

Elkington was the son of a gilt toy and spectacle maker, and was apprenticed in 1815 to his two uncles—Josiah and George Richards—to learn the craft of silver-plating, which consisted in those days of beating out and spreading very thin veneers of silver over base metals, such as copper. Adhesion was secured by a process of soldering and rolling. Young Elkington quickly made his mark and was elevated to the status of a partner. When the two uncles died, he found himself sole proprietor. For some time after acquiring the business in this fashion, he worked on his own, but eventually took into the business as a partner his cousin, Henry Elkington, who displayed much initiative in seeking out and applying new processes and techniques.

Preceding John Wright, there had been other experimenters, including Bessemer, Jacobi and Spence, who had attempted to apply the principle of electrolytic deposition of one metal upon another. The Elkingtons investigated the results of these experiments, gave encouragement where merited, and generally kept their fingers on the pulse of a rapidly developing science. Between 1836 and 1838 they took out various patents, including one for "mercurial gilding," and when Wright the surgeon came along, with his solutions of the cyanides of gold and silver, the Elkingtons were at once interested. They arranged for the process to be patented, and paid Wright a royalty during the remainder of his lifetime, and an annuity to his widow after his death.

These then were the scientific bases upon which Elkington built up his business—and this, despite opposition from the established trade, soon began to prosper. In 1841 a large works was completed in Newhall Street, Birmingham, and fresh capital having become an urgent necessity, a certain Josiah Mason was admitted to the firm as a partner.

He, too, was a somewhat remarkable character, who had started life in the most humble circumstances, by selling cakes in the street, and as an itinerant greengrocer. He started business in a small way as a manufacturer of steel pens and was lucky enough to find an outlet in London for his entire output and before he died the pen manufactory was employing over a thousand workpeople. He was knighted in 1873 by letters patent.

Josiah Mason provided the Elkingtons with much needed finance and made a very considerable sum of money out of his association with electro-plating; he was worth over half a million pounds at the time of his death in 1881.

Widespread Sales

The Elkingtons, having overcome the hostility of the older generation of silver-platers, were soon pushing their products all over the country, and these were snatched up with alacrity by thousands, particularly electro-plated tea-pots, forks and spoons and other articles of household use. By the late 'forties Elkington wares were gracing every Victorian table, except the most exclusive, which could afford to retain solid silver.

The firm's products were displayed at the Great Exhibition of 1851, and as a result the reputation of the Elkingtons soared. The new, and attractively priced, electro-plated goods achieved a tremendous vogue, and one feels sure that the primitive batteries installed in the Birmingham works were continually being exhausted.

Not many years after the Exhibition the industry which the Elkingtons had founded was given a further stimulus as a result of fresh advances in the field of electrical science. As far back as 1836, the voltaic cell had been superseded by the improved Daniell cell. In 1859 the Planté accumulator made its appearance and, from 1860, direct current began to become available in greatly increasing quantities as a result of the invention of the dynamo. This revolutionized a hundred and one different industrial processes — but particularly electro-plating.

In the course of their progress the Elkingtons came into competition with a French inventor, a M. de Ruolz who, simultaneously with the Elkingtons, had evolved a basically similar electro-plating technique on the other side of the Channel. When the Elkingtons sought to take out a patent in France, in 1842, they were opposed.

The parties, however, avoided costly litigation by coming to terms with one another and the honours of the inventions were shared. For example, one reads in the *Journal* of the Royal Society of Arts for 1864 that the Monthyon Prix, consisting of a gold medal and twelve hundred francs (worth somewhat more than they would be to-day) were divided between M. de Ruolz and the Elkingtons, to the complete satisfaction of both.

Developments in France

A certain M. Christofle then steps into the picture so far as France is concerned. This gentleman, obviously impressed by the possibilities, spent his entire personal fortune, amounting to half a million francs, in buying up the patents. Then he raised another 1½ million francs from among his friends, and emulating George Richards Elkington, started off the French electro-plating industry. It soon attained considerable economic importance, and M. Christofle, besides amassing a handsome fortune, was awarded the Cross of the Legion of Honour. His enterprise, in 1859, had a capital of 2½ million francs, and employed 1,500 people.

In the year after the Great Exhibition the Elkington partnership was broken by the death of the cousin, Henry, who had proved his worth in the Newhall Street business, more especially on its artistic side.

The older man, George Richards Elkington, carried on for another fourteen years. The pioneering spirit was still strong in him and, in association with Sir Josiah Mason, he set up a great copper-smelting enterprise at Pembrey, Carmarthenshire, as well as continuing to devote his energies to the works in Birmingham—in which city, incidentally, he passed the whole of his busy, and yet uneventful, life. He died in 1865, and the business passed to his son.

Irish Restrictions

OUR Dublin correspondent says that there has been a general relaxation of the restrictions on the use of electricity in the Irish Republic imposed last May. The Board is now able to increase the ration as the result of its overhauling of plant during the last few months. Also, part of the new stations at Allenwood and on the Erne will be in commission by the close of the year. Some of the plant has been held up in Liverpool by the Dublin dock strike.

In the official announcement making known these facts, the Electricity Supply Board states that demand continues at such a high level that rationing is still essential to ensure the necessary economy in use and some reasonable spread of the available supply. It is very pleased by the public's response to the restrictions.

The general domestic ration will be increased from the present 75 per cent to 90 per cent of the amount used during the corresponding period of last year. No new connections for space heating, water heating, cooking and process heating will be made "for the time being."

Electric fires which are prohibited at present will be allowed, provided the consumer keeps within his ration. After-hours shop window lighting and outside electric signs are prohibited until after 7 p.m. The ration for water heating, where separately metered, will be increased from 50 to 75 per cent and there will be no restrictions where use is limited by time switch controls to between 11 p.m. and 8 a.m.

The new ration for space heating in offices and shops, etc., is up to 75 per cent of last year's consumption. Lighting in shops, offices, and institutions will be allowed up to the full consumption of the corresponding period of last year. Storage heating by consumers, including domestic users, will be limited to 75 per cent.

Electricity in Ships

Widening Scope and Diversity of Uses

IT was natural that electrical services in ships should be chosen as the subject of the inaugural address of Mr. E. W. Ashby (British Insulated Callender's Cables, Ltd.) as chairman of the Mersey and North Wales Centre of the Institution of Electrical Engineers at Liverpool which, as a port, is deemed to be second only to London in respect of value and volume of goods dealt with. Mr. Ashby said that at the Liverpool headquarters of many shipping companies plans and specifications were prepared for new ships and their equipment. The choice of machinery was not an easy one; an unfortunate irony of these post-war years was that availability should so often be the decisive factor in choice of equipment.

Electric propulsion could be used in conjunction with either steam turbines or diesel engines and, while retaining the particular desirable features of either, would combine those of its own, but it was more expensive, heavier and slightly less economical than direct or geared drive. In addition to the inherent smoothness of drive, the interposition of electric transmission between the propeller and the prime mover reduced the risk of vibration.

Diesel-electric Drive

Steam turbine electric drive was established among the recognized standard systems of propulsion. It was claimed that the attraction of diesel-electric drive for medium sized cargo vessels lay in the use of a number of smaller, higher speed engines of standardized production design, driving —for ease of parallel operation—a.c. generators. This arrangement was more flexible, the amount of plant in operation was readily adjusted to load conditions at sea or in port, the units were easily handled for repairs or replacement, and the standby equipment and spares were reduced to the minimum.

A few ships had been built with 3, 4, or 6 main diesel alternators; the saving in weight was some 20 per cent of the weight of a direct driving engine and became about the same as the steam turbo-electric combination. Paralleling might be simplified, but experience in one ship with units of over 1,000 h.p. had shown that diesel alternators of this size running in parallel and supplying a single propulsion unit could suffer from excessive engine wear, which had been attributed to the relative incidence of engine impulses. When small craft were engaged in services which called for long stand-by periods the economy of diesel machinery was obvious. If, in conjunction, electric propulsion were used, the main generators could be arranged to provide for the special purposes of such vessels as dredgers, fire floats, etc., with complete control from the bridge for manœuvrability in harbours or narrow waters. In such cases d.c. was a complete success, making use of Ward-Leonard or constant-current control. There were examples of each at present in service on the River Mersey.

Oil Tankers

An outstanding feature of post-war shipbuilding had been the great programme of oil tanker construction. About 43 per cent of existing world tanker tonnage was diesel driven. If there had been free choice, it was believed some owners would have preferred electric propulsion. Electrical equipment was subject to special requirements, restricting some circuits to 115 V.

Under the influence of land practice there had arisen in the last few years a very lively interest in the use of a.c. for marine auxiliaries. Probably the objective most desired was to free electrical machinery from commutators and brushgear and it was suggested that weight, initial cost, and maintenance could be reduced by using the simple and robust squirrel-cage motor. Similar economies would result from running auxiliary alternators at speeds higher than those possible for d.c. generators and by the use of three-phase distribution.

For ships in the Royal Navy a.c. at 60 c/s had been adopted as a standard, in line with U.S. naval and merchant marine practice. No frequency standard had been

determined for British merchant shipping, but it was argued that 50 c/s equipment would be more easily obtainable and that when in port a standard shore supply would be available, thus permitting the shutting down of all engines, freeing them for overhaul and also releasing staff.

It was doubtful whether the benefits of distribution at a higher voltage could be made use of to economic advantage, and some relaxation would be required as to maximum voltages permitted by the Classification Societies, which at present were limited by the I.E.E. Rules and Lloyd's Register to 440/250 V for power. Switchgear for a.c. was much more expensive than for d.c., but a.c. auxiliaries had been used to a small extent mainly on special purpose vessels. Further experience was necessary to show how far direct starting could be employed before excessive voltage disturbance necessitated the use of special rotor types with increased initial costs. Regulations prohibited the bringing in of spare generating plant for the purpose of meeting the peak demand during the starting up of auxiliary machinery.

The major obstacles to the use of a.c. were in replacing the d.c. motor for cargo winches and in speed regulation for pumps and fans. At least two winches incorporating a.c. motors had emerged. In view of the criticism directed against a.c. contactors for marine duty, it was of interest to note that in both these designs the contactors were operated by d.c. from rectifiers.

One of the winches had a series characteristic commutator motor with a tapped transformer contained in the bed-plate. The mechanical assembly was normal, the prototype had been in service for twelve months, and the performance was claimed to be entirely suitable for the duty. The other winch employed two squirrel-cage motors coupled in line through fluid couplings to a differential gear. Three speeds were obtained on the differential output shaft, which was also the worm shaft of the winch.

With the highly developed machinery and refinements now in use a ship represented a very costly investment, and the considerable progress that had been made in naval architecture and marine engineering towards achieving greater economy at sea had brought into sharp relief the much longer time now spent by ships in port. Routine servicing and overhaul costs had risen sharply, but the loss of time was more serious. Greater concern, however, was occasioned by the delays in the case of cargo ships loading and unloading.

On the Mersey Dock Estate the cargo transit sheds were electrically equipped to a considerable extent, but were severely damaged by enemy action. The programme of reconstruction and modernization was a heavy one; with the completion of present commitments the Board would have in commission a total of 196 electric cranes and transporters. Inside the sheds electric trucking was widely used, trucks and mobile cranes being either battery driven or supplied through a flexible cable on a self-winding drum and connected to a wall-mounted plug box.

Floating cranes had proved of great value; the Mersey Docks and Harbour Board had on order a 25-ton crane and yet another of 100 tons was contemplated. They would be electrically operated with Ward-Leonard control which had been so satisfactory on the 200-ton *Mammoth* which had two sets of triple expansion steam engines coupled either for propulsion or for driving the generators, and the crane functions were carried out by ten 100 h.p. motors.

Speed of Light

LAST year we commented on experiments at the National Physical Laboratory which had shown the figure normally accepted for the speed of light to be inaccurate by eleven miles a second. The apparatus used for the determinations will be on show at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2, until 30th November. It is a cavity resonator in which a radio wave is reflected backwards and forwards. When the time of travel between the two ends equals the time interval between successive waves, they build up to electrical resonance which can be detected with very high precision. Visitors will be able to do this themselves.

The time of travel is about one ten thousand millionth of a second, which means that the waves follow one another at a frequency of 10 thousand million a second and it is necessary to measure this frequency with an accuracy better than one part in a million. The dimensions of the resonator had to be accurate to one hundredth thousand of an inch and the Metrology Division of the N.P.L. had to devise new ways of making the required accuracy of measurement.

RECENT INTRODUCTIONS

NOTES ON NEW ELECTRICAL AND ALLIED PRODUCTS

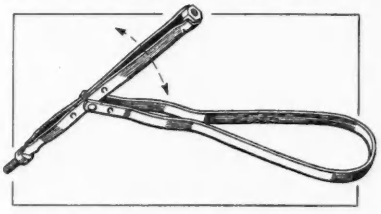
Flexible Tubular Heaters

A RANGE of tubular heaters introduced by the GENERAL ELECTRIC Co., LTD., Magnet House, Kingsway, London, W.C.2, makes a complete range of heaters available from a stock of 23 individual items. Whereas 280 items were previously required to enable a wholesaler to hold stocks in three voltages, only 35 will be required in the future.

If banks of two-, three- or four-way heaters are required, the end sheath and cap of each tube is replaced by the appropriate terminal box. The terminal boxes are supplied with two, three or four ways, each with busbars to provide solid interconnecting links and a single cable connection. Each pack containing the terminal box and busbars also contains the necessary brackets for either wall or floor mounting. Single-way tubes are supplied in lengths from 2ft to 15ft.

Instrument Screwdriver

Instrument makers and wireless mechanics often have occasion to assemble screws and nuts in inaccessible places. A special purpose screwdriver designed to overcome these



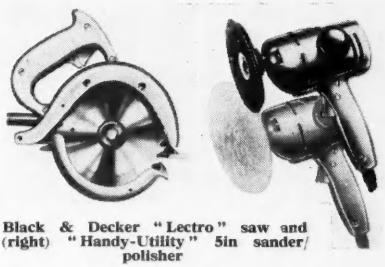
Special purpose screwdriver

difficulties is now available from LEWIS SPRING Co., LTD., Resilient Works, Redditch, Worcester. The screw is held for positioning by the forked end of the driver which is closed together and inserted into the slot of the screw. Similarly, small nuts can be held by the other end of the instrument.

Electric Tools

Following the introduction of the ¼in "Handy Utility" drill, BLACK & DECKER, LTD., Harmondsworth, have now produced three new items in the same series, the "Handy-Utility" 5in sander/polisher, the 6in "Lectro" saw and a ¼in drill.

Suitable for sanding, polishing and drilling a



Black & Decker "Lectro" saw and (right) "Handy-Utility" 5in sander/polisher

wide variety of materials, the first item comprises, apart from the sander/polisher itself, a 5in rubber pad, three sanding discs, a lambswool bonnet, a ¼in chuck, tins of wax and car polish. It is priced at £9 17s 6d. Accessories (costing 32s 6d) include a disc sanding table attachment, comprising a 5in metal sanding plate, clamp-on sanding table, three assorted sanding discs, a mitre gauge and disc cement; 3in wire cup brushes and 4in wire wheel brushes can also easily be attached. In addition the horizontal stand can be used with the sander/polisher enabling it to be clamped horizontally to a bench for stationary work, or alternatively the vertical stand can be used as a drill press.

Five different kinds of blades enable the 6in "Lectro" saw to be used for a variety of purposes in general carpentry, construction, alterations and farm maintenance jobs. It stops as soon as switched off and a telescoping blade guard which closes as the saw is lifted gives complete safety. The price is £15 15s. Accessories include a depth and bevel attachment (35s) and a rip fence (8s 6d) which fastens to the depth and bevel attachment giving a handy guide for rip cutting.

The ¼in drill has a capacity from ¼in to ½in in steel and up to 1in in wood. It also drives hole saws up to 3in diameter in sheet materials. The price is £11 7s 6d, a bench stand for use with it costing £5 10s.

Trolleys for Washing Machines

Trolleys suitable for use in conjunction with Hoover and "Goblin" washing machines are now available from CHARDCRAFT PRODUCTS, LTD., 124, St. Margaret's Road, Twickenham, Middlesex. The units are constructed with hardwood frames and are fitted with composition castors and footbrakes with rubber or plastic covered pedals. The washing machine is

simply placed on the trolley with the foot pedal on the same side as the wringer handle. The machine can then be moved about when full of water and pressure on the foot brake holds it steady when the wringer is in use. The model for the Hoover machine measures 13⅜in by 11⅜in by 4in, weighs 4½ lb and costs 27s 6d. The "Goblin" model weighs 7 lb, measures 20⅝in by 17½in by 5½in and costs 59s 6d.

Torch Stands

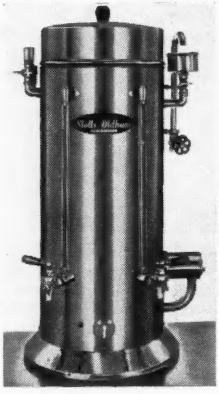
A simple but useful device by which tubular electric torches can be used in awkward places where it is required that both hands shall be free is obtainable from M. G. E. Lloyd, 35, Ashfield Road, Acton, London, W.3. As the illustration shows, it is a wire stand secured to the torch by a clip and two holding screws with spring washers. The circular base of the wire stand is large enough to clear the head of the lamp when the stand is swung up out of use. There are four sizes for torches of different patterns and the height ranges from 5⅜in to 6¾in. The stand also enables the torch to be set in an upright position if necessary.

Left: **Tubular torch stand**

Right: **Teledictor model B125 a.c. solenoid**

Coffee Maker

In the latest electrically heated Continental coffee maker produced by James Stott & Co. (Engineers), Ltd., Vernon Works, Oldham, the exterior casing has been completely redesigned and several detail improvements further increase efficiency.



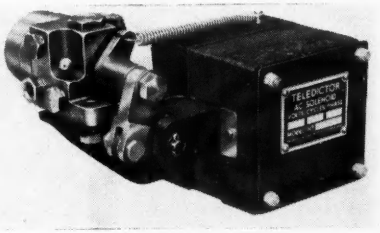
Stott coffee maker

The machine operates on the principle of displacement of water by generation of steam pressure in the space above it, through a dip tube. Up to 18 pints of coffee can be made at a time at approximately 30 minute intervals. A tap is provided on the jacket of the appliance from which small quantities of water can be drawn for making other beverages.

Heating is by means of a 3 kW grid type immersion element, "Simmerstat" controlled and incorporating a safety cut-out device. It is impossible to draw off sufficient water to uncover the elements. The price of the apparatus is £72 5s.

A.C. Solenoids

Two new forms of a.c. solenoid have been introduced by Teledictor, Ltd., 214, Birmingham Road, Dudley, Yorks. Model A125 is the standard unit, and Model B125 is fitted with an end cheek having an additional bracket on to which a separate piece of equipment requiring actuation can be mounted. Both units can be fitted with hold-on contacts for interlocking on automatic sequence applications. The gross pull at 85 per cent line voltage is 15 lb and the solenoids are available for operation at from 100 to 500 V at normal supply frequencies. The dimensions of the standard model are 4in by 3⅝in by 3⅝in and the plunger has a maximum stroke of 1·25in.



Dry Batteries

A SPECIFICATION prescribing the dimensions and performance of dry batteries for domestic radio receivers and allied equipment, B.S. 1766: 1951, has been published by the British Standards Institution, 24, Victoria Street, London, S.W.1, price 2s post free. Experience has shown that the information in B.S. 397: 1946 "Leclanche-type primary cells and batteries," in respect of dry batteries for radio receivers is inadequate in the light of present day needs and it was, therefore, decided that requirements for such batteries should be the subject of a separate British Standard. The present publication embodies the relevant data from B.S. 397 together with details of the sizes of radio battery plugs, and a description of the connectors. The provisions of B.S. 397, in so far as they apply to radio receivers, are superseded by this standard.

ELECTRICITY SUPPLY

Advertisement Lighting Control

Recent Power Plant Contracts

FROM this week until 19th October electricity from the public supply must not be used for shop window and other advertisement lighting between the hours of 7 a.m. and 1 p.m., Mondays to Fridays. Thereafter, until 4th April, the period of restriction is from 7 a.m. to 7 p.m. Outside these times there will be no restrictions, and there is no limitation on the use of electricity generated by private plant. The Licence made by the Minister of Fuel and Power under the Electric Lighting (Restriction) Order, 1949, also excludes 25th and 26th December in England and Wales and 25th December and 1st January in Scotland. Restrictions on the standard of interior lighting permitted in shops, hotels and catering establishments will also be subject to the alteration of hours as stated.

Commenting on the new restrictions, Mr. Bernard Moss, secretary of the Electrical Sign Manufacturers' Association, said that the Ministry's announcement should remove all fears that the coming winter would see another complete ban on the use of electric signs. The fact that the Ministry had announced restricted hours for the whole of the winter until 4th April, 1952, showed that it was adhering to its promise to the Association not to ban electric signs again.

B.E.A. Contracts

During the past month the British Electricity Authority has placed contracts for equipment for power stations, transforming stations and transmission lines amounting in the aggregate to £2,742,613. The principal contracts include the following:—

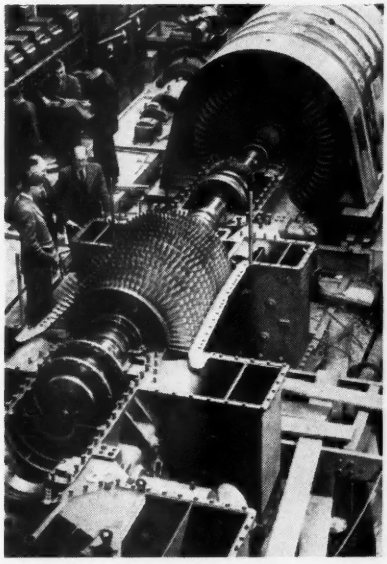
Acton Lane " B " power station, Willesden: One 240,000 lb/hr boiler and coal transportation plant.—Mitchell Engineering, Ltd. Tilbury station: Coal unloading cranes.—Stothert & Pitt, Ltd. Drakelow station, Burton-on-Trent: Cooling tower.—Mitchell Construction Co. Meaford " B " station, near Stone, Staffs: High pressure pipework and valves (Babcock & Wilcox, Ltd.) and auxiliary switchgear and accessories.—A. Reyrolle & Co., Ltd. Stourport " B " station: High pressure steam piping.—Aiton & Co., Ltd. Connah's Quay station, Chester: Generator transformers.—C. A. Parsons & Co., Ltd. Auxiliary switchgear.—A. Reyrolle & Co., Ltd. Chadderton station, Oldham: 3,300 V auxiliary switchgear and accessories.—English Electric Co., Ltd. Roosecote station, Barrow: Condensing water system.—Bierrum & Partners, Ltd. Goldington station, Bedford: 132 kV 2,500 MVA switchgear.—A. Reyrolle & Co., Ltd. Three Bridges substation, Sussex: 132 kV 2,500 MVA switchgear.—English Electric Co., Ltd. Stella South, Blaydon-on-Tyne: 132 kV 3,500 MVA switchgear.—A. Reyrolle & Co., Ltd.

Reinforcement at Barrhead

Because of the growth in the demand for electricity at Barrhead, the South West Scotland Electricity Board is to reinforce the electricity network there. The scheme, which is estimated to cost £11,000, will involve the laying of an 11 kV underground cable for $1\frac{3}{4}$ miles and the installation of additional equipment in two existing electricity substations.

South Shields Contract Policy

South Shields Town Council has rejected a proposal by the Electrical Contractors' Association that electrical fittings should be included in



Engineers discussing assembly points of the new gas turbine set being installed at Trafford power station, Manchester

contracts for electrical work. At present, the North Eastern Electricity Board assists the Council in preparing specifications, and electrical fittings are obtained from the Board. The Council has decided that this system, under which the Council receives a special discount from the Board of 15 per cent, shall be continued, and electrical contractors carrying out jobs for the Council will be allowed a 5 per cent discount on list prices for electric fittings supplied by the Corporation.

Sewage Works Plant

Swindon Corporation Sewage Works & Water Works Committee recommends that, subject to the approval of the Minister of Local Government and Planning, approval should be given to the scheme providing for the utilization of the gas produced by sludge digestion for the generation of electricity. For this purpose two dual fuel engine driven alternator sets and other ancillary equipment will be required at an estimated cost of £12,500.

"Arsenal" Floodlighting

Carried out by the team's own electrical staff, a new floodlighting installation at the Arsenal football ground, Highbury, consists of a total of eighty-four 1,000 W projectors on the roofs of the east and west stands, spaced at intervals of about 7ft. Each projector is connected to the circuit by a length of c.t.s. and a watertight socket outlet. There are separate switchboards for the control of the floodlighting in the basement of each stand. The cables are run in galvanized conduit and each switchboard consists of an ironclad main switch, and eight ironclad distribution switches.

Battery of floodlighting projectors at the Arsenal football ground

European Electric Power

The Committee on Electric Power of the United Nations Economic Commission for Europe held its eighth session from 1st to 3rd October. It examined the reports of the seven groups of experts which have met since the last session, and a number of studies prepared by the Commission's secretariat. The Committee on Electric Power had before it two legal texts prepared by the experts. The first aims at simplifying existing legislation governing exports and imports of electric power and formulates uniform recommendations for all European countries. The second aims at simplifying customs, fiscal and administrative formalities hampering the construction of hydro-power stations on frontier waterways.

Other matters considered were rural electrification, storage pumping, the gross potential water power resources in Europe, the stability of interconnecting networks, model contracts for the supply of electric power, and transfers of power across frontiers.

At the end of the session, members of the Committee visited hydro-electric installations at the invitation of the Swiss authorities.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 26th October:—

LEWMEXBOND. No. 692,008. LEWENBOND. No. B692,009. Class 9. Insulated electric wire and fuse wire.—London Electric Wire Co. & Smiths, Ltd., 24, Queen Anne's Gate, Westminster, London, S.W.1.

NAMROD. No. 698,039. Class 9. Electric batteries.—C. Dorman, Ltd., Nairobi, Kenya Colony. Address for service, c/o Bowring, Jones & Tidy, Ltd., Coffee Department, 107, Fenchurch Street, London, E.C.3.

VICTROMETER. No. 699,095. Class 9. Instruments for measuring and visually indicating X-ray and similar radiations.—Newton Victor, Ltd., 15–19, Cavendish Place, London, W.1.

ISOTRON. No. 699,457. Class 9. Static eliminators being electrical apparatus.—Isotope Developments, Ltd., Finsbury Pavement House, 120, Moorgate, London, E.C.2.

PHILHARMONIC. No. 700,118. Class 9. Radio and television sets (complete).—Asher Landau, 248–250, Bishopsgate, London, E.C.2.

LASCOM. No. 700,175. Class 9. Combined radio and navigation apparatus and instruments, signalling apparatus, and television apparatus and instruments, and parts included in Class 9 of all the said goods.—Land, Air & Sea Instrument Co., Ltd., 14, Southampton Place, Bloomsbury, London, W.C.1.

DIADEM. No. 700,236. Class 9. Gramophones, receiving sets for wireless telephony, radiogramophones, and parts included in Class 9.—J. S. Bush, 22, Chandos Court, Southgate, London, N.14.

PLUTO. No. 689,980. Class 11. Electric light bulbs.—Christie & Sadler, Ltd., Pluto House, 68, Finsbury Pavement, London, E.C.2.

AURALITE. No. 698,485. Class 11. Lighting fittings wholly or principally of prismatic glass or of similar light transparent prismatic material, for use in buildings.—Holophane, Ltd., Holophane House, Elverton Street, Vincent Square, London, S.W.1.

FINANCIAL SECTION

Company Notes and Stock Exchange Activities

Reports and Dividends

Berry's Electric, Ltd.—The annual meeting was held on 2nd October, Mr. R. Berry (chairman) presiding. In his circulated statement the chairman said the improvement in results had been maintained despite the high rate of purchase tax levied upon their main products and other restrictions in the home market placed upon the sale of electric fires and space heaters as a result of the national electric power shortage. There was a considerable increase in export sales of "Magicoal" fires, particularly to the United States, where they had established showrooms in Fifth Avenue, New York. Production and sale of their other products, lighting fittings, water heaters and switchgear, showed a marked increase. They were becoming actively engaged in rearmament contracts and were making and preparing to make a wide range of electrical equipment for Government Departments.

Scottish Cables (South Africa), Ltd.—Presiding at the first annual meeting on 1st October, Mr. W. Fraser (chairman) said that since taking over the works from Rhodesian Cables, Ltd., a complete wire drawing plant had been installed which was now on the point of completion and should be in production almost immediately. A five years' agreement had been entered into with Scottish Cables, Ltd., Renfrew, whereby the latter had undertaken to act as commercial and technical advisers. While Scottish Cables, Ltd., had passed over the goodwill and connection which they had built up in South Africa to the South African company, they would still supply cables and other ancillary equipment not manufactured by the South African company, which would act as the Renfrew company's representatives. During the year under review many important contracts had been executed for various classes of cables throughout the Union of South Africa and the Rhodesias.

Lindley Thompson Transformer (Holdings), Ltd.—Application has been made to the Stock Exchange for permission to deal in, and quotation for, 100,000 6 per cent cumulative redeemable preference £1 shares and 4,600,000 ordinary 1s shares in this company, the registration of which appears on page 758. The company has been formed to acquire the whole of the issued share capital of the Lindley Thompson Transformer & Service Co., Ltd. (the operating company). The preference shares will be placed at 21s per share and the ordinary shares at 1s per share. The placing will be done by Whitehead Industrial Trust.

Engineering Components, Ltd., proposes to raise its authorized capital to £600,000 by the creation of 1,500,000 5s ordinary shares of which 500,000, capitalizing £125,000 of general reserve, will be issued to stockholders on the basis of four shares for every £1 of existing stock. The new ordinary stock will not rank for the interim dividend of 10 per cent already declared, but subject thereto will rank *pari passu* in all respects with the existing issued ordinary.

Stothert & Pitt, Ltd., report a profit for 1950-51 of £216,383, as compared with £233,738 for the preceding year, and after allocating sums to various reserves and making other provisions, it is proposed to pay a final dividend of 5 per cent and a bonus of 1¼ per cent, making 11¼ per cent for the year on the £400,000 ordinary capital as increased last December by a scrip bonus of 33⅓ per cent. This compares with a distribution of 15 per cent in the previous year on the old capital. The balance carried forward is £86,550 (against £86,379).

Vactric, Ltd., reports a net profit, before taxation, of £243,149 for the year ended 31st March last, as compared with £80,340 for the preceding year. Taxation requires £68,712 and £48,000 is placed to loans repayment reserve. The balance carried forward is £97,260 (against a debit of £29,177 brought in). No preference dividend in respect of the parent company has been paid for the half-years to 30th September, 1950, and 31st March, 1951, and no ordinary dividend is recommended. The last ordinary distribution was 22½ per cent for the year 1944-45. The directors propose to ask preference shareholders to agree that the cumulative sinking fund should not be applied in the redemption of preference shares until Treasury loans have been repaid. If this is agreed to, the directors hope that it will be practicable to resume payment of the preference dividend.

Thos. W. Ward, Ltd., reports a group profit for the year ended 30th June last, after deducting taxation of £1,064,290 and making various allocations, of £992,676, as compared with £561,076 for 1949-50. After deducting minority interests of £40,797 and profits retained in subsidiary accounts £109,006, the

parent company's net profit is £842,873 (against £418,109). The final ordinary dividend is 10 per cent, again making 15 per cent for the year. In addition a sum to cover a bonus of 5 per cent, less tax, will be set aside to be paid at an appropriate date.

Lightalloys, Ltd., reports a profit for the year to 1st July last of £45,197, as compared with £50,463 for the previous year, and after deducting £28,154 for taxation, there is a net profit of £17,043 (against £23,210). The dividend for the year is maintained at 20 per cent by a final payment of 15 per cent, and £4,443 is carried forward (against £11,031).

Peto-Scott Electrical Instruments, Ltd., reports a group profit for the fifteen months ended 30th June last of £8,046, as compared with a loss of £8,558 for the preceding year. It is proposed to pay a dividend of 12½ per cent for the fifteen months (against nil), on the £45,000 capital. It is also proposed to increase the capital to £90,000 and make a bonus issue of one new share for each share held.

Aeronautical & General Instruments, Ltd., reports a group profit for the year ended 31st March last of £48,168, as compared with a loss of £7,664 for 1949-50. After making various allocations, it is proposed to pay an ordinary dividend for the year of 5 per cent (against nil). The balance carried forward is £25,611 (against £19,621 brought in).

The Telegraph Condenser Co., Ltd., has declared an interim dividend of 5 per cent. This is at the same rate as for the previous year, but is paid on capital increased by a 33⅓ per cent bonus.

The Marconi International Marine Communication Co., Ltd., has declared an interim dividend of 4 per cent (against 2½ per cent).

New Companies

Lindley Thompson Transformers (Holdings), Ltd.—Registered 28th September. Capital £100. To acquire and hold shares, stocks, debentures; and to carry on the business of designers, manufacturers, repairers, importers and exporters of and dealers in all kinds of electrical plant and machinery, etc. Solicitors: Richards Butler & Co., 11, Waterloo Place, S.W.1; and Stafford Clark & Co., 3, Laurence Pountney Hill, E.C.4.

Caslip, Ltd.—Registered 26th September. Capital £100. Manufacturers, suppliers, contractors and repairers of and dealers in electrical, electronic, atomic, radio, chemical, scientific and mechanical equipment and plant, etc. V. A. D. Kent is the first director. Regd. office: 9, Cavendish Square, W.1.

T. K. Richardson & Co., Ltd.—Registered 26th September. Capital £2,000. To acquire the business of an electrical contractor, and electrical, radio and television engineer carried on by T. K. Richardson at 66, Aigburth Road, Liverpool. Directors: T. K. Richardson and P. R. Richardson. Regd. office: 66, Aigburth Road, Liverpool, 17.

Homelab Instruments, Ltd.—Registered 2nd October. Capital £500. To acquire the business of manufacturers of instruments for the radio and allied industries carried on by Colin Knox and R. F. Herbert at Leytonstone, E.11, as Homelab Instruments. Directors: C. Knox and R. F. Herbert. Regd. office: 68a, Cobden Road, Leytonstone, E.11.

Hartley-Oerlikon Electrodes, Ltd.—Registered 29th September. Capital £100. Manufacturers of electrical welding electrodes and equipment, general sheet metal welders, etc. Directors: R. G. Cooke and A. W. M. Hartley. Regd. office: 1a, Harrington Road, South Kensington, S.W.7.

Liquidation

Kamba Electric, Ltd.—Meetings of members and creditors on 5th November at 20-21, Lawrence Lane, Cheapside, London, E.C.2, to receive an account of the winding up by the liquidator, Mr. A. E. Attwood.

Bankruptcies

W. E. Holloway, formerly of "Riverview," Burton Road, Ness Holt, Wirral, Ches, and trading as Dominion Electric Heating Co., 23, Market Street, Birkenhead, electrical contractor.—Last day for receiving poofs for dividend 30th October. Trustee, Mr. R. C. Johnston, 59, Hamilton Square, Birkenhead.

R. Davidson, Sea Links, Chyngton Road, Seaford, company director, formerly 41, Bramber Road, Seaford, and carrying on business at 199, High Street, Lewes, as an electrical illuminating engineer.—Last day for receiving proofs for dividend 24th October. Trustee, Mr. J. S. Bradley-Hole, 7, Old Steine, Brighton, 1.

B. Goldenberg, carrying on business at 49, Deansgate, Manchester, under the style of B. Goldie & Co., dealer in electrical goods.—Last day for receiving proofs for dividend, 19th October. Mr. F. C. Ormrod, Official Receiver's office, 20, Byrom Street, Manchester, 3.

G. C. Higgins, 8, Carlton Road, Whalley Range, Manchester, electrician, formerly carrying on business at 45, High Street, Sandbach, Chester, as an electrical contractor.—Adjourned examination to be proceeded with on 16th November at the Court House, Quay Street, Manchester, 3.

L. O. Richardson, lately carrying on business at 205, Railton Road, Herne Hill, London, electrical engineer.—First and final dividend of 7d in the £, payable 31st October at Bankruptcy Buildings, Carey Street, London, W.C.2.

STOCKS and SHARES

STOCK Exchange business and prices are pursuing a fairly steady course ; although, with popular interest rising in election matters, it is not to be expected that attention will be greatly fixed upon stocks and shares. The usual uncertainties attaching to a General Election are present in full force, having the effect, on one hand, of restraining investment from realizing its securities, and, on the other hand, of laying a hand of caution upon investment in undertaking new ventures. On the whole, prices are holding their ground with firmness. The main features of the moment are to be found in the foreign bond market where Japanese and German bonds have been fluctuating wildly. Tokyo Electric 6 per cent bonds were 63 last January, 103 a month ago, and now stand at 143.

Election Markets

Prices in the electrical equipment and other sections of the industrial markets have been running along quietly on much the same level as was ruling immediately before the polling-day decision. The flare-up which received so much publicity on the day after the announcement was extinguished almost at once, although it still apparently serves as election propaganda. It seems generally agreed that present share prices do appreciably discount the expectation that a change of Government may produce a fairer field for industrial investments. Any tendency to celebrate such an event, however, would be sobered by the serious state of affairs disclosed in the latest trade and gold reserve returns, and by the evidence, in election manifestos, that company profits are suspect in the eyes of both the major parties.

Week's Price Changes

Ericssons Telephones are $\frac{1}{16}$ up at 51s 3d and Telegraph Constructions at $2\frac{1}{8}$ are similarly better. British Insulated Callender's, 36s 6d, Enfield Cables, 34s 6d, Globe Telegraph & Trust, 26s 6d, are better on the week. Associated Electricals have risen to 90s, General Electrics to 95s 6d, and British Aluminium to 43s 9d. Cossor, 17s 3d, and E.M.I., 23s 9d, are 9d up in each case, and in the heavy group Babcock & Wilcox at 80s 6d are 1s 3d higher. Falls include Tube Investments, $6\frac{1}{2}$, Reyrolle, $4\frac{1}{2}$, Lucas, 42s 6d, Decca, 20s 6d, and Telephone Properties, 32s 6d.

Electrical Appliances

Among the best of recent company results have been those of the Vactric and Morphy-Richards companies, both well-known names in the field of domestic appliances and other electrical equipment. Vactric's results showed net profits, after tax, at about three times the previous figure. Prior obligations in respect of loans from the Treasury, and the banks, still preclude the payment of preference or ordinary dividends. On the latest evidence of progress, however, the 5s ordinary shares improved to 10s, and the preference to 16s 9d. A resumption of preference dividends will, it is hoped, become practicable if approval is given to the company's proposal in connection with the use of the sinking fund. Morphy-Richards' group profits were more than doubled in the year ended last June. With the dividend maintained at 40 per cent, the 4s shares at 18s 9d pay $8\frac{1}{2}$ per cent on the money.

Telegraph Condenser Dividends

The interim dividend of 5 per cent declared last week by Telegraph Condenser is at the same rate as last year's corresponding payment, but is payable this time on ordinary capital increased from £150,000 to £200,000 as a result of the one-for-three share bonus. The total paid on the smaller amount for 1950 was raised from 15 to 20 per cent, but involved the distribution of no more than £16,500 net out of surplus profits of £136,000. On the basis of such figures, shareholders might be excused for reading hopeful implications into the capital bonus decision. On the other hand, they have had subsequently to consider the contingency of a reduction on last year's payment if nothing happens to put the dividend control plan out of court. Similar states of indecision are of course common just now to numbers of securities in the industrial market and are responsible, to a large extent, for the present restraint on investment. The price of Telegraph Condensers has hardened $\frac{1}{16}$ to 42s 6d.

Company Results

Peto Scott Electrical Instruments 2s ordinary shares were quoted at 2s $4\frac{1}{2}$d after publication of the dividend and preliminary figures. Profit of the holding company, for fifteen months, of £8,880, after tax, compares with a loss of £5,900 for the preceding year, for which no dividend was paid. This time, shareholders receive $12\frac{1}{2}$ per cent, and an issue of shares at par (2s), on a one-for-one basis, is proposed. The 4 per cent interim dividend declared by the Marconi International Marine Communication Co. came as something of a surprise, for it breaks a long and unbroken line of $2\frac{1}{2}$ per cent interim payments. These were followed for many years by a final of 5 per cent, which, however, was increased last time to $7\frac{1}{2}$ per cent on the strength of the marked expansion of profits in 1950. A large proportion of the company's capital is held by Marconi's Wireless Telegraph Co., which, in turn, is controlled by English Electric. In both these cases, the position would apparently become complicated if dividend control were to materialize.

NEXT WEEK'S EVENTS

Monday, 15th October

BIRMINGHAM.—Grand Hotel, 6.15 p.m. Birmingham Electric Club. "The Equipment of a Television Studio," by F. C. McLean.

BRISTOL.—Electricity House, Colston Avenue, 6 p.m. I.E.E. Western Supply Group. Chairman's Address, by E. N. Evans.

LIVERPOOL.—Liverpool Royal Institution, Colquitt Street, 6.30 p.m. I.E.E. Mersey and North Wales Centre. "Switchgear for Station Auxiliaries," by W. A. Snodgrass.

LONDON.—Savoy Place, W.C.2, 7 p.m. I.E.E. London Students' Section. Chairman's Address, by K. C. Pounds.

Caxton Hall, Westminster, S.W.1, 7 p.m. E.P.E.A. London Technical Group. "Simple Outline of the Factors Influencing the Stable Operation of an Electric Power System," by A. H. Gray.

NEWCASTLE-ON-TYNE.—King's College, 6.15 p.m. I.E.E. North-Eastern Radio & Measurements Group. Chairman's Address, by W. W. Campbell.

READING.—George Hotel, 7 p.m. I.E.E. District meeting. "The Relation between American Universities and Industry," by Dr. P. Dunsheath.

Tuesday, 16th October

CAMBRIDGE.—Post Office Training School, 61, St. Andrews Street, 6 p.m. I.E.E. Cambridge Radio Group. Chairman's Address, by G. C. Greenwood.

LEEDS.—Lighting Service Bureau, 24, Aire Street, 6.30 p.m. I.E.E. North Midland Utilization Group. "Modern Developments in Electric Welding," by Dr. H. G. Taylor.

LONDON.—Savoy Place, W.C.2, 6 p.m. Institution of Electrical Engineers, Education Discussion Circle. Discussion on "The 'j' Operator Method of Calculation—When and How should it be Introduced?" opened by A. W. Gillies.

At the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1, 5.30 p.m. Institute of Fuel. Melchett Lecture on "Combustion Processes in Engines," by Prof. F. H. Garner.

At the Institution of Electrical Engineers, Savoy Place, W.C.2, 2.30 p.m. Institution of British Agricultural Engineers. Presidential Address, by F. E. Rowland.

Lighting Service Bureau, 2, Savoy Hill, W.C.2, 6.30 p.m. Association of Supervising Electrical Engineers. Presidential Address, by T. G. N. Haldane.

MANCHESTER.—Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Measurements Group. "Performance Limits in Electrical Instruments," by Dr. A. H. M. Arnold, and "The Accuracy of Measurements of Electrical Standards," by A. Felton.

Wednesday, 17th October

BIRMINGHAM.—College of Technology Refectory, Suffolk Street, 7 p.m. I.E.E. South Midland Education Discussion Circle. "Treatment of Transients for Electrical Students," opened by C. F. Partridge

BRIGHTON.—Technical College, 6.30 p.m. I.E.E. Southern Centre. "The Protection of Electrical Power Systems—A Critical Review of Present-Day Practice and Recent Progress," by H. Leyburn and C. H. W. Lackey.

COVENTRY.—Technical College, 7.15 p.m. A.S.E.E. Coventry Branch. "Supervisory Remote Control Equipment."

EDINBURGH.—Heriot-Watt College, 7 p.m. I.E.E. Scottish Centre. Chairman's Address, by P. Butler.

HULL.—Y.E.B. Ferensway, 7.30 p.m. I.E.E. North Midland Centre. District meeting. Address by the chairman, Dr. E. C. Walton.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Radio Section. Chairman's Address, by Dr. D. C. Espley.

I.E.E. London Students' Section, 2.30 p.m. Visit to Fraser & Chalmers, Erith, Kent.

RUGBY.—College of Technology & Arts, 6.30 p.m. I.E.E. Rugby Sub-Centre. "The Construction of Staythorpe Power Station," by K. D. Snadden (Joint meeting with the Rugby Engineering Society.)

SHEFFIELD.—Grand Hotel, 6.30 p.m. I.E.E. Sheffield Sub-Centre. Chairman's Address, by J. E. Pegg.

Wednesday, 17th October, to Saturday, 27th October

LONDON.—Earls Court. International Motor Exhibition.

Thursday, 18th October

DUBLIN.—Trinity College, 6 p.m. I.E.E. Irish Branch. Chairman's Address, by B. O'Mongain.

LONDON.—Dorchester Hotel, Park Lane, W.1, 7 for 7.30 p.m. Institution of Mechanical Engineers. Annual dinner.

PLYMOUTH.—Grand Hotel, 3 p.m. I.E.E. South-Western Sub-Centre. Chairman's Address, by S. G. Monk.

SPALDING.—Corn Exchange, 7 p.m. I.E.E. East Midland Centre. District meeting. "The Phase/Neutral System of Supply for Rural H. V. Distribution," by G. T. Garwood and G. J. Websdale.

TYTHING.—Talbot Hotel, 7.15 p.m. Worcester Electric Club. "Electric Lamps," by F. Jamieson.

Friday, 19th October

BIRMINGHAM.—Grand Hotel, 7 for 7.30 p.m. Birmingham Electric Club. Ladies' Evening.

LONDON.—Storey's Gate, St. James's Park, S.W.1, 5.30 p.m. Institution of Mechanical Engineers. Presidential Address, by A. C. Hartley.

Caxton Hall, Westminster, S.W.1, 7.30 p.m. Junior Institution of Engineers. Annual dance.

MANCHESTER.—Engineers' Club, Albert Square, 6.45 p.m. Manchester Association of Engineers. "Electric Power Distribution in Factories," by E. Jacks.

STOKE-ON-TRENT.—M.E.B. Showrooms, 7 p.m. I.E.E. North Staffordshire Sub-Centre. "The Application of Gas-Turbine Technique to Steam Power," by J. F. Field.

Copeland Arms Hotel, Glebe Street, 7.30 p.m. A.S.E.E. Crewe Branch. "A.C. Motors and Control Gear," by F. T. Bartho.

Saturday, 20th October

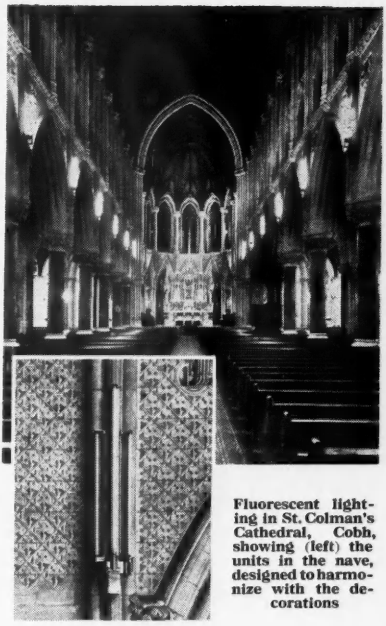
LONDON.—Hyde Park Hotel, Knightsbridge, S.W.1, 7 for 7.30 p.m. Electrodepositors' Technical Society. Annual dinner-dance.

Cathedral Lighting

THE new lighting installed by the staff of the Irish Electricity Supply Board in St. Colman's Cathedral, Cobh (formerly Queenstown), consists of eighteen units each consisting of one 4ft 40 W lamp flanked by two 3ft 30 W hot cathode fluorescent lamps in the nave, and fourteen units of similar design each comprising one 2ft 20 W lamp flanked by two 18in 15 W h.c. fluorescent lamps in the side aisles.

The larger nave units are mounted 25ft and the smaller side aisle units 10ft above floor level. The sanctuary and high altar are lighted by twenty-six single 5ft 80 W lamps on channel type bases. Two of the side altars are provided with six similar units each and each of the other two side altars with four units. All altar and sanctuary units are concealed from view from the body of the cathedral. The control equipment for altar and sanctuary units is housed in the channel bases, but the units mounted in the nave and side aisles carry only their starters in their bases and their control gear has been concealed at clerestory level and suitable points along the side aisles. All lamps are "natural" colour.

Satisfactory "seeing" conditions have been created with a relatively low measure of foot-candles at pew level. The illumination levels are a flat 2ft-candles throughout the body of the cathedral at pew level and 6ft-candles over the entire area of the sanctuary and all altars. In daylight the nave and side aisle units are scarcely noticeable, while at night they convey the impression of groups of candles which provide adequate and even illumination over the whole area of the interior. Details of the architecture and embellishments are clearly distinguishable up to the highest point of the ceiling. The lamps and their control gear were supplied by the General Electric Co., Ltd., and the special lighting units were manufactured in Dublin by John Smyth & Sons, Ltd., to working drawings prepared by Mr. Boyd Barrett, architect.



Fluorescent lighting in St. Colman's Cathedral, Cobh, showing (left) the units in the nave, designed to harmonize with the decorations

Bakers' and Confectioners' Exhibition

All Machinery Electrically Driven

THE progress made in the application of electricity to the production of bread and confectionery was much in evidence last week at Olympia, London, where the 43rd International Bakers' and Confectioners' Exhibition, the first since the war, was held. Virtually every machine was electrically driven.

As an indication of developments in the mechanized production of bread, it is now possible on a plant made by Atlas Equipment (London), Ltd., to produce 12,000 rolls an hour with only one man feeding the dough into the hopper; all the other processes, dividing, moulding, conveying and setting on to the stove, are automatic. Another one-operator machine by S. Ayres Jones & Co., moulds loaves at a rate of 2,000–3,000 per hour, coating them with a film of vegetable oil which does away with the necessity for greasing the bread tins.

Other new items of special interest were a gravity feed slicer (Hobart), a sectional oven (Spooner), dough mixing and kneading machines with interlocked arm mechanism (Artofex), rotary moulding machines producing biscuits of almost any shape and size (John Pelkman), an automatic cutlery washing machine (Concentric), a 600 loaves an hour bread wrapper for small bakeries (C. S. du Mont), chocolate enrobers (Walter Denis Contact Co., Ltd.), a 200 dozen per hour automatic doughnut machine (British Doughnut Co.), a 165 tray dough retarder

capable of handling 750 pounds of dough a day (Marco Refrigerators), a 500 an hour cake wrapping machine (Funditor), a 44 per minute depositor (Oddys) and a 200 quart vertical mixer (James Cruickshank).

Thermostatically controlled three-deck pastry ovens embodying the latest sheathed wire elements were among the products of the General Electric Co., Ltd., whose display also comprised a thermostatically controlled peel type baking oven with rise and fall doors, fluorescent lighting fittings, water and space heating apparatus.

Electric vehicles are being increasingly used for bakers' delivery work and three firms showed examples, Partridge, Wilson & Co., Ltd., Austin Crompton Parkinson Electric Vehicles, Ltd., and Smith's Electric Vehicles, Ltd., the last-mentioned company introducing a new mobile bakery and confectionery shop. An electric vehicle was also displayed by the Electrical Development Association whose exhibit emphasized the cleanliness, convenience, simplicity and other special features which rendered electricity so ideally suitable for the baker and confectioner.

Increased Output in Singapore

Construction of New Power Station

THE municipal electrical engineer at Singapore (Mr. C. C. Payne, M.I.E.E.) reports further progress by the Electricity Department in 1950. The total kWh generated amounted to 186·8 million, an improvement of 17·91 per cent over the previously recorded best annual total (1949). While the installed generating plant capacity remained at 37,000 kW, the peak load increased from 32,000 to 34,500 kW. During the past three years the number of consumers connected has risen by 2,065, 3,097 and 3,375, respectively, making the total number 43,419.

A total sum of over $18 million was approved for various contracts for the new power station at Pasir Panjang. The largest contract was for the first section of the construction of the civil works (George Wimpey & Co., Ltd., $9,618,563), others being for steelwork (Redpath Brown & Co., Ltd., $2,100,000), boilers and pipework (Babcock & Wilcox, Ltd., $1,627,714), oil storage plant (Whessoe, Ltd., $746,529), and main and auxiliary switchgear (Reyrolle & Co., Ltd., $2,508,480). In November the Municipal Commissioners approved the calling of tenders for two further 25,000 kW turbo-alternators and two 187,500 lb/hr boilers together with a 2,000 kW gas turbine driven alternator as house set. This plant is to be installed during 1954/1955 at an estimated cost of $17 million and will make the total capacity of the new power station 100,000 kW.

Owing to staff shortages in both the power station and distribution sections, maintenance of supply was due in no small measure to the efforts made and long hours worked by the staff. The shortage of generating plant necessitated load shedding on 58 occasions during the year, for a total of 141½ hours, or an average of 2·44 hours upon each occasion.

Cable laying was extensive and additions to the network aggregated 35 miles of h.v. and 23 miles of l.v. cables. Hired appliances continued to make a popular appeal to the domestic user, the respective increases being as follows (totals on hire in parentheses):—Fans 2,925 (12,121), water heaters 415 (1,314), cookers 741 (1,738), and motors 48 (487). The public lighting section installed 783 lamps, making the total at 31st December, 1950, 2,758 with an illuminated mileage of 71. The main point of interest was the installation of fluorescent street lighting in dual carriageway formation along the centre of the road in Collyer Quay.

In Fullerton Road and the Collyer Quay area of Singapore 5ft 80 W "Mazda" fluorescent lamps provide an evenly distributed and glare-free light

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s each) will be obtainable after 21st November from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1946

37351. White, E. L. C.—Scanning circuits for cathode-ray tubes. 24th October, 1947. (661264.)

1947

3357. White, E. L. C.—Circuit arrangements embodying cathode-ray tubes. 15th January, 1948. (661266.)

3722. British Thomson-Houston Co., Ltd., and Gabor, D.—Electric discharge devices sensitive to infra-red rays. 5th August, 1948. (661162.)

4919. White, E. L. C.—Modulator circuit arrangements. 31st January, 1948. (661267.)

13412. Telefonaktiebolaget L. M. Ericsson.—Switching devices for the setting of cross-bar switches by means of markers. 19th May, 1947. (661163.)

17177. Clive, G., Lyonnet, A., and Boiteux, M.—Apparatus for measurement of power, voltage and current. 30th June, 1947. (661164.)

17597. Roussel, G. H. J.—Variable volume devices. 3rd July, 1947. (Cognate application 17598, 17th March, 1947.) (661165.)

22874. Sonotone Corporation.—Electric signal transducer units. 18th August, 1947. (661168.)

23423. Patelhold Patentverwertungs- & Elektro-Holding Akt.-Ges.—Arrangement for the secondary intensity control of cathode-rays. 25th August, 1947. (661366.)

27351. Schweig, B. F.—Silvering of glass and other electrical non-conductors. 29th September,1948. (661270.)

29995. British Thomson-Houston Co. Ltd.—Vinyltetrahydronaphthalenes and methods of preparing the same. 11th November, 1947. (661368.)

35191. Philips Electrical, Ltd.—Radio apparatus for indicating distance. 31st December, 1947. (661177.)

1948

744. Philips Electrical, Ltd.—Electronic amplifiers for use on centimetre wavelengths. 9th January, 1948. (661180.)

7933/4. Monochrome, Ltd., and Wilsdon, S. C.—Electrolytic treatment of metallic surfaces. 17th March, 1949. (661273/4.)

8756. Standard Telephones & Cables, Ltd.—Pulse electronic switching systems. 25th March, 1948. (661182.)

10772. Philips Electrical, Ltd.—Circuits for generating pulses of current or voltage. 19th April, 1948. (661377.)

11535. Philips Electrical, Ltd.—Systems for producing phase-modulated oscillations. 27th April, 1948. (661378.)

15160. Cinch Manufacturing Corporation.—Holders for electron valves. 4th June, 1948. (661279.)

16806. Faudell, C. L., and Bull, E. W.—Circuits for generating sawtooth waveforms. 2nd June, 1949. (Cognate application 21895, 19th August, 1948.) (661563.)

18318. British Thomson-Houston Co., Ltd.—Electric discharge devices. 7th July, 1948. (661389.)

19756. British Thomson-Houston Co., Ltd., Ridout, W. H., and Clarke, M. G.—Electric discharge devices such as tubular lamps. 11th May, 1949. (661564.)

26518. Constantine, W. W. (General Motors Corporation).—Electric circuit overload protective device. 12th October, 1948. (661282.)

1949

181. Standard Telephones & Cables, Ltd.—Landing information radio receiving system. 7th January, 1949. (661394.)

850. Almar-Naess, A., and Rolfsjord, N. O.—Remote control system for arc electro-welding apparatus. 18th January, 1949. (661567.)

889. British Thomson-Houston Co., Ltd., and Melville, W. S.—Protection of radar equipments. 11th January, 1950. (661193.)

2457. Metropolitan-Vickers Electrical Co., Ltd.—Equipment for measuring the speed of rotation of rotating apparatus. 17th January, 1950. (661201.)

2675. Minister of Supply.—Current pulse generating circuit arrangements. 16th January, 1950. (661410.)

2737. Duch, G. V. A., and Duch, M. A.—Process for electrically butt-welding or butt-soldering wires, conductors, tubes, plates and other metallic elements. 1st February, 1949. (Convention date not granted.) (661202.)

2752. British Thomson-Houston Co., Ltd., Blood, W. R., and Moore, J. W. Production of fluorescent electric discharge lamps. 25th January, 1950. (661412.)

2978. C.A.V., Ltd.—A.c. electric dynamos. 16th January, 1950. (661569.)

4350. Triggs, W. W. (Aktiebolaget Kanthal).—Heating elements for electric furnaces. 17th February, 1949. (661469.)

4792. British Tabulating Machine Co., Ltd.—Electromagnetic relays. 22nd February, 1949. (661471.)

5205. Western Electric Co., Inc.—Electrical amplifier circuits. 25th February, 1949. (661219.)

5398. West & Co., Ltd., A., and Pavitt, F. J.—Electrical switch mechanism and tripping means therefor. 28th February, 1950. (Cognate application 6147, 7th March, 1949.) (661222.)

5895. Sinke, C.—Electric lead interconnector. 3rd March, 1950. (661480.)

6071. Baker & Son, Ltd., E., and Perry, A.—Foot-operated controllers for electric motors. 23rd February, 1950. (661225.)

6118. Cooke & Ferguson, Ltd., Buttrey, R. N., and Males, R. J.—Pneumatic operating mechanism for electric circuit-breakers. 27th January, 1950. (661226.)

6454. General Electric Co., Ltd.—Multi-channel electric pulse-signalling systems. 8th June, 1950. (661229.)

6726. Western Electric Co., Inc.—Translating devices and systems for electromagnetic waves. 11th March, 1949. (661486.)

7301. Lucas, Ltd., J.—Machine for use in the construction of wound armatures for dynamo-electric machines. 8th March, 1950. (661233.)

7444. English Electric Co., Ltd.—Jewelled footstep bearings. 20th March, 1950. (661294.)

8215. United Carr Fastener Corporation.—Two-part electrical connectors. 25th March, 1949. (661418.)

8312. Anderson, J. M.—Electrically heated frying-stoves. 13th February, 1950. (661582.)

8875. Spackman, C.—Electromagnetic motor and drive to power spindles. 1st April, 1949. (661589.)

9691. Winther, M. P.—Eddy-current brakes or clutches. 9th April, 1949. (661590.)

9849. Watson, F. (Aktiebolaget Elektrolux).—Driving couplings of electrically driven kitchen machines. 12th April, 1949. (661593.)

10018. Philips Electrical, Ltd.—Folded-dipole aerials 13th April, 1949. (661240.)

10081. Fkg.f. Kesselring Geratebau Akt.-Ges.—Electric converting apparatus. 13th April, 1949. (661304.)

10280. Ekco-Ensign Electric, Ltd., and De Boo, W.—Holders for tubular electric lamps. 17th April, 1950. (661597.)

10354. British Thomson-Houston Co., Ltd.—Constant torque devices. 19th April, 1949. (661422.)

10790. United Aircraft Products, Inc.—Electromagnetically controlled devices. 22nd April, 1949. (661303.)

11123. Hawkins & Co., Ltd., L. G., and Hawkins, L. G.—Automatic electrically heated apparatus for making beverages. 26th April, 1950. (661601.)

11744. Electric & Musical Industries, Ltd.—Reduction of the angle-modulation of amplitude-modulated oscillations. 25th April, 1950. (661603.)

11747. Westinghouse Brake & Signal Co., Ltd., and Sheppard, E. A.—Light signals. 5th April, 1950. (661311.)

11803. Rheostatic Co., Ltd.—Electric thermostats. 3rd May, 1950. (661242.)

12165. British Thomson-Houston Co., Ltd.—Thermostats. 6th May, 1949. (661313.)

12203. Bernard, J., and Joiris, A.—Transformer tanks. 6th May, 1949. (661423.)

12452. British Thomson-Houston Co., Ltd., Read, J. C., and Carrick, G. A.—Cooling of mercury arc rectifiers. 21st March, 1950. (661243.)

12536. Scholes & Co., Ltd., G. H., and Pearce, G. S.—Three-pin socket electrical connectors. 4th April, 1950. (661611.)

12990. Cole, Ltd., E. K., and King, A. E.—Anchoring means for electric conductors in radio or like equipment. 15th May, 1950. (661318.)

13003. Edison Swan Electric Co. Ltd., and Pocock, S. N.—Light energy comparators. 27th February, 1950. (661425.)

13272. Westinghouse Electric International Co.—Fluorescent screens. 18th May, 1949. (661320.)

13277. Tesla, National Corporation, and Carniol, B.—Method of and a device for a quick measurement of inductance, capacity and resonance frequency of tuned circuits with a small quality factor. 18th May, 1949. (661321.)

13396. Sala, P.—Alternating-current electromagnets. 19th May, 1949. (661324.)

13664. Measurement, Ltd., Hewlett, S. J., and Wolfenden, R. H.—Electrical integrating meters and indicating instruments. 18th May, 1950. (661496.)

13833. Compagnie de Produits Chimiques et Electrometallurgiques, Alais, Forges et Camargue.—Spectrographic apparatus. 24th May, 1949. (661497.)

13850. Philips Electrical, Ltd., Nemet, A. A., and Lambert, R. A.—Electric transformer systems for supplying X-ray tubes or the like. 24th May, 1949. (661613.)

14117. Soc. Anon. pour les Applications de l'Electricité et des Gaz Rares-Etablissements Claude-Paz & Silva.—Process for feeding in parallel two electric discharge tubes. 26th May, 1949. (661426.)

14207. Automatic Telephone & Electric Co., Ltd.—Piezo-electric crystal assemblies. 24th April, 1950. (661614.)

14931. Micafil Soc. Anon.—Winding former for winding the stators of electric machines by mechanical means 3rd. June, 1949. (661616.)

15668. British Thomson-Houston Co., Ltd.—Polymers of 2-vinyldibenzothiophene. 13th June, 1949. (661503.)

15889. Cole, Ltd., E. K., Collins, B. F., Martin, A. W., and Cox, V. J.—Radio ground control equipment for aircraft. 12th June, 1950. (661245.)

15982. A.B. Metal Products, Ltd., and Reeves, J. A.—Electric switches of the wafer type. 15th May, 1950. (661331.)

18105. British Tabulating Machine Co., Ltd.—Trigger circuits employing grid controlled tubes. 8th July, 1949. (661335.)

18113. Western Electric Co., Inc.—Frequency selective circuits. 8th July, 1949. (661631.)

18269. British Thomson-Houston Co., Ltd.—Dynamo-electric machines. 11th July, 1949. (661633.)

18830. Akt.-Ges. Brown, Boveri & Cie.—Betatron-started synchrotrons. 18th July, 1949. (661247.)

18875. Dixon, M. G. (Aerotec Corporation).—Pressure-actuated electric switches. 18th July, 1949. (661635.)

19636. Radio Corporation of America.—Impedance measuring. 26th July, 1949. (661338.)

20106. Philips Electrical, Ltd.—Sources of radiation comprising luminescent substances. 2nd August, 1949. (661513.)

20397. Igranic Electric Co., Ltd.—Electric transformers. 5th August, 1949. (661340.)

20621. Metropolitan-Vickers Electrical Co., Ltd.—Fluxmeters. 8th August, 1949. (661342.)

21770. Bendix Aviation Corporation.—Transmitting units for electrical movement-transmitting systems. 22nd August, 1949. (661442.)

23104. Erie Resistor Corporation.—Electrical condensers. 6th September, 1949. (661520.)

23297. Belling & Lee, Ltd.—Aerials. 19th April, 1950. (661521.)

24161. Westinghouse Electric International Co.—Relay systems for protecting alternating current circuits. 20th September, 1949. (661449.)

26039. Westinghouse Electric International Co.—Insulation and cooling of electrical apparatus. 11th October, 1949. (661531.)

26976. Du Mont Laboratories, Inc., A. B.—Ground connection for ultra-high-frequency electrical connections. 20th October, 1949. (661536.)

28057. Pirelli-General Cable Works, Ltd., and Ashford, B. O.—Electric cables. 21st April, 1950. (661540.)

28569. Schweig, B. F.—Silvering of glass and other electrical non-conductors. 29th September, 1948. (Divided out of 661270.) (661346.)

28632. Triggs, W. W. (National Battery Co.).—Storage battery with concentric cells. 8th November, 1949. (661642.)

31271. Philco Corporation.—Portable electrical apparatus. 6th December, 1949. (661551.)

31527. Philips' Electrical, Ltd.—Variable inductance coils of the sliding-core type. 8th December, 1949. (661647.)

31552. British Thomson-Houston Co., Ltd.—Radio receivers. 8th December, 1949. (661553.)

32297. Standard Telephones & Cables, Ltd. (International Standard Electric Corporation).—High-frequency pre-emphasis for pulse code modulation. 16th December, 1949. (661554.)

1950

14799/0. Cinch Manufacturing Corporation.—Holders for electron valves. 1th June, 1948. (Divided out of 661279.) (661349/0.)

14801/3. Cinch Manufacturing Corporation, and Evans, A. J. S.—Electrical contacts for holders for electron valves. 4th June, 1948. (Divided out of 661279.) (661351/3.)

1951

9629. Constantine, W. W.—Electric circuit overload protective device. 12th October, 1948. (Divided out of 661282.) (661360.)

Athlone Fellowship Scheme

THE first Canadian engineering graduates to receive awards under the new Athlone Fellowship scheme have arrived in this country. Beginning this year, thirty-eight Athlone Fellowships are to be awarded each year by the Government to enable Canadian engineering graduates to take post-graduate training in the United Kingdom. Fellowships will cover the cost of transport, fees and maintenance and be tenable normally for a maximum period of two years. They will be available for one of the following options: (a) works training in one or more approved industrial organizations; (b) post-graduate study in a United Kingdom university or college or research establishment; (c) a combination of (a) and (b); or (d) research in a United Kingdom University leading to the degrees of M.Sc. or Ph.D.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section, the date of the issue is given in parentheses.

Australia.—BRISBANE.—11th January. City Council. Six 5,000 kVA, 33 kV step down transformers. (C.R.E. (I.B.) 71898/51. Ten/3035.)*

State Electricity Commission of Queensland. 12th December. Supply of small distribution type transformers for the Townsville Regional Electricity Board. (C.R.E. (I.B.) 71931/51. Ten/3032.)*

Bingley.—9th November. U.D.C. Street lighting installations. (See this issue.)

Exeter.—29th October. City Council. Switchgear for Pynes Waterworks. (See this issue.)

India.—BOMBAY.—30th November. Electric Grid Offices. Supply of one 7,500 kW set and two 40,000-50,000 lb/hr boilers for the Utran power station of the South Gujarat electric grid scheme. (C.R.E. (I.B.) 72063/51. Ten/3054.)*

Longbenton.—3rd November. U.D.C. Electrical installations in 16 houses and 10 bungalows. (See this issue.)

New Zealand.—WELLINGTON.—6th November. New Zealand Post Office. Supply of 500 miles of cadmium-copper wire. (C.R.E. (I.B.) 71971/51. Ten/3047.)*

Uruguay.—MONTEVIDEO.—19th November. Usinas Electricas y Telefonos del Estado. Supply of single-phase and three-phase meters. (C.R.E. (I.B.) 71950/51. Ten/3052.)*

Wiltshire.—2nd November. County Council. Electrical installation in new secondary modern schools, Malmesbury. (See this issue.)

ORDERS PLACED

Berwick (Northumberland).—Town Council. Supply and erection of 22 steel columns with vertical lanterns for the lighting of Royal Tweed Bridge.—G.E.C.

Chester.—Corporation. Electrical installation in new Blacon Infants' School (£4,059).—Merseyside & North Wales Electricity Board.

Dudley.—Corporation. Electrical installations in a further 289 houses (£6,493).—Goldsmith & Cantrill.

Glasgow.—Corporation Education Committee. Completion of electrical work at Notre Dame (New) High School for Girls (£7,049).—Osborne & Hunter.

North Riding.—County Council. Rewiring west wing of County Hall, Northallerton.—Hardisty & Nelson, Northallerton.

Peterborough.—City Council. Electrical installations in 134 houses on the Eastfield estate (£4,370).—M. F. Hansen.

Sheffield.—Corporation. Electrical installations in 822 dwellings on Basegreen estate (£17,360).—Hobson & Scott, Ltd.

South Shields.—Town Council. Rewiring Barnes County Junior Boys' and Girls' School (£1,511).—Watson-Norie, Ltd. Similar work at Westoe County Secondary Boys' and Infants' School (£2,550).—R. Ramsay & Son.

CONTRACTS IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Abingdon.—Dwellings (56), Lamborough Hill estate, Wootton; surveyor, Rural Council Offices.

Barnet.—Flats (33), Oaknede site, Bells Hill; A. S. Mays, clerk to U.D.C., Municipal Offices, Wood Street.

Barrow-in-Furness.—Extensions at North Lonsdale Hospital (£50,400); Wm. Hull & Sons, Ltd., Rawlinson Street.

Bebington.—Houses (40), Mill Park estate; borough surveyor.

Bedford.—Police houses on the Mile Road, Old Ford End Road and Eastcotts Road housing estates; borough surveyor.

Bingham.—Additions at Saxondale Hospital; Sheffield Regional Hospital Board, Fulwood House, Old Fulwood Road, Sheffield.

Birkenhead.—Commercial garage at corner of Elmswood Road and Borough Road for Messrs. Hardings; R. & E. J. Eccles, architects, Hamilton Square.

Bolton.—Extensions at Lostock for De Havilland, Ltd.; James M. Monro & Sons, architects, 32, Clarendon Road, Watford.

Bradford.—Extensions to textile department, Technical College (£139,864); L. & W. Morrell, Ltd., builders, Low Moor, Bradford.

Bromley.—Shops and offices, 12/18, High Street; Kentish Times, Ltd., Times Buildings, Sidcup.

Cardiff.—Technical college, Western Avenue (£237,000); city engineer, City Hall.

Croydon.—Industrial development on site at New Addington; Magnet Matchworks, Ltd., 71, Lincoln's Inn, London, W.C.2.

*Specifications may be inspected at the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, S.W.1 (Victoria 9040).

Doncaster.—Proposed neighbourhood unit at Cantley; estates surveyor, 15, South Parade.

Gateshead.—Pithead baths at Watergate Colliery; Page, Son & Hill, architects, 75, King Street, South Shields.

Grimsby. — Bus garage and workshops, Garden Street; Lincolnshire Road Car Co., Ltd., Bracebridge Heath, Lincoln.

Leeds.—Hostel for ageing persons, Moorfield House estate, Scott Hall Road; city architect, Quarry Hill, 9.

Liverpool.—Factory at Fleming Road and Woodend Avenue for Distillers (Biochemicals), Ltd.; Wm. Thornton & Sons, Ltd., Liverpool.

London.—HOMERTON.—Adaptations (£45,000) at Eastern Hospital; F. W. Mackenzie, architect, 235, Regent Street, W.1.

NORWOOD.—Adaptation of former Hippodrome Theatre, Crown Hill, as departmental stores; British Home Stores, Ltd., 129, Marylebone Road, N.W.1.

Luton.—Flats (72), on six sites; borough engineer, Town Hall.

Manchester. — Three-storey extension to works; Associated Technical Manufacturers, Ltd., Woodward Street.

Mansfield.—Ward block at Ransom Sanatorium for Sheffield Regional Hospital Board; Bromley & Cartwright, architects, 6, Clarendon Street, Nottingham.

Newcastle-on-Tyne.—Houses (99) and flats (26) on the Montagu estate; William Leech (Builders), Ltd., Clayton Street, Newcastle.

Church, Ponteland Road; Edwards & Manby, architects, 52, Eldon Place, Newcastle.

New Malden.—Factory and laboratories, Burlington Road; Decca Navigator Co., Ltd., 1, Brixton Road, S.W.9.

Newport (Isle of Wight).—Offices and warehouse, Pyle Street; Edward Morris, Ltd., Emor House, High Street.

Houses (52), Pan estate; A. E. Jukes & Son, Ltd., builders, Crocker Street.

Newquay.—Secondary modern mixed school for Cornwall E.C.; county architect, County Hall, Truro.

Northampton.—Flats (74), King's Heath; borough architect.

North Shields.—New coal staiths at Whitehill Point for Tyne Improvement Commission, Bewick Street, Newcastle-on-Tyne (£600,000); R. B. Porter, chief engineer to the Commission.

Oxford.—New bakery, Botley Road; Oxford & District Co-operative Society, Ltd.

Paignton.—Concert hall for U.D.C.; surveyor, Municipal Offices, Oldway, Paignton.

Perth.—Houses (100) for T.C.; burgh surveyor, City Chambers, Perth.

Peterborough.—Houses (50), Mountsteven Avenue site; F. J. Smith, city engineer, Town Hall.

Pontllanfraith. — Factory, Penmaenan; Dulcet Confectionery Co., 74, Chase Road, N.W.10.

Pontyclun.—New brewery for South Wales & Monmouthshire United Club Brewery, Ltd.; John Morgan, Ltd., builders, Cathedral Road, Cardiff.

Shoreham-by-Sea.—Eight-class school, for West Sussex E.C.; county architect, County Hall, Chichester.

Southport.—Houses (50), Heathfield Road estate; town planning officer, Pavilion Buildings, Lord Street.

South Shields.—Additions to works, Harton Lane, for Harton Dyeworks, Ltd.; Page, Son & Hill, architects, 75, King Street, South Shields.

Block of flats in Wellington Street for the T.C. (£77,000); Carruthers & Son, builders, Heugh Terrace, South Shields.

Swinton and Pendlebury.—R.C. secondary modern school, Stanwell Road; Wm. Ellis, architect, Barclays Bank Chambers, St. Helens.

Twickenham. — Dwellings (53), Towfield Road, Butts Farm site; A. S. Knolles, borough surveyor, Municipal Offices.

Wakefield.—Rebuilding and extensions at Ings Road for Williams & Womersley, Ltd.; A. Clifford Green, Ltd., Market Street, Wakefield.

Widnes.—Phase 1 of college of further education; county architect, County Offices, Preston.

Wolverhampton.—Houses for T.C. at Tettenhall: Nathan Hyde, Ltd., 6, Claremont Road, Sedgley (54 houses); F. & G. Bradford, 21, Cherry Street (34); Clayton Bros., 18, Old Heath Road, Heath Town (12); Barnett & Co., Westbury Street (8); Washbourne Bros., Ltd. (8) and J. W. Lindsay, 9, Mill Lane (6).

NEWS FROM FRANCE

From Our Paris Correspondent

THE first French Television Salon was held from 28th September to 10th October in Paris. It included exhibition halls where television receivers were exhibited and a 700-seat theatre for showing television programmes. The theatre was used as a studio outside normal broadcasting hours for variety, interviews and programmes including the public. During broadcasting hours it was used for organized programmes and for two galas.

Paris is to replace its 8,000 gas lamps by fluorescent lamps within the next few years to improve the city's lighting at a reduced cost. There is some talk of a five-year programme to effect the replacement.

The fifth and last generating group of the Genissiat barrage is now in service, adding 65,000 kW to the total, which now amounts to 335,000 kW.

A $1,100,000 credit has been granted under the Marshall Plan to enable France to buy American equipment for a large boiler for the Arrighi power plant at Vitry-sur-Seine. This equipment will enable a second 100,000 kW group to be installed, raising the capacity of the plant to 400,000 kW.

A 100,000 kW generating group is to be supplied by Brown Boveri to the French Grossbliedershoff plant in the Lorraine Basin.